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1882 "	45	" "		1890 "	289	" "
1883 "	63	" "		1891 "	325	" "
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Electric Clocks. THE method of Mr. Hefner-Alteneck for operating electric clocks from central electric light stations (see Digest) deserves careful attention, as it points out not only another source of profit for central stations, but also a great convenience for the public. From the abstract it will be seen that the clock is placed in the circuit of an ordinary incandescent lighting service in the same manner as a lamp, the only wiring being a pair of conductors. The clock is automatically wound up and is synchronized daily by merely lowering the voltage for an instant, at the station, at a given hour. The winding up mechanism seems to be the only complicated part, but a small motor might be substituted for this with an attachment similar to that used with water-tank electric pumps.

Economic Operation of Electric Railways. WE have recently referred several times to the "Penny wise, pound foolish" policy that so often characterizes the management of central stations and electric railways, and some more definite information on the subject of the latter is given in this issue. It is not to be wondered at that the compound engine is sometimes pronounced inefficient, as the power station referred to by Mr. Hasson is probably not the only one in which the high-pressure cylinder has to do work against the low pressure one. The niggardly policy of the company referred to is further shown by, apparently, their refusal to pay for the test which pointed out the means of a great saving in operating expenses. The article on "Electric Traction on the Pacific Coast" is very suggestive from the contrast it presents between the results of proper attention to railway motors and the reverse. The methods employed on the roads where the service is satisfactory are similar to those advocated recently in our columns by Lieut. Cahoon. The inspector states that "The secret of these good results undoubtedly lies in the fact that no car is allowed to run longer than four weeks without being overhauled." In addition, the motors are inspected every night, and it is shown that one man and a helper can thus look out for 25 cars.

The Education of Engineers. ONE of the results of the recent Engineering Congress at Chicago was the formation of a Society for the Promotion of Engineering Education. If the same lively interest is shown at its annual meetings as was displayed, judging from the number of papers read, at the sessions of the educational division of the Engineering Congress, out of which it grew, there is promise of a useful future for the society. While there has been much discussion of the methods of engineering education, it has been so scattered and so desultory in character that much of its value has been lost. The society will serve a good purpose, not only in concentrating views and experience and rendering them available for reference to all interested, but also, in time, by bringing discussion to bear on definite points of real value. While the society will undoubtedly have a wide field of usefulness, yet the all-powerful factor of personality in teaching, which it cannot effect, will retain its ascendency. An Arnold or a Ferraris teaching by a wrong method would probably accomplish more than men of less marked personality teaching by a perfect one, and, what is more, their usefulness might be lost if they were compelled to follow a course marked out by others.

The Steam Turbine. PROF. KENNEDY has recently made a test in England of Parsons' steam turbine at which a remarkable efficiency was developed. The turbine used steam of 100 pounds pressure and ran at about 4,500 revolutions per minute. It was coupled to a dynamo, and only used 20.3 pounds of steam per electrical horse power at 164.9 e. h. p., and 20.8 pounds at 148.5 e. h. p. Assuming the efficiency of the dynamo to be 90 per cent. these quantities become 18.27 and 18.72 respectively. Even making allowance for the fact that superheated steam was used on this trial, the results will compare favorably with the efficiencies of the best types of modern compound engines, and are far superior to those of high-speed compounds. The steam turbine has a number of advantages, among which are its high speed and the small space it occupies. Whether the wear of its working parts is greater or less than that of an ordinary steam engine we do not know. The only machine of this type that has come under our observation was one some years ago when the steam turbine was scarcely out of the experimental stage; the one in question had been in use about a year driving a dynamo and gave perfect satisfaction. When the engineer was asked in regard to the interior he said he knew nothing about it, as there had been no occasion to examine its working parts since received—which certainly speaks well for its mechanical efficiency. The perfect balance of the working parts and their comparative simplicity are good points, but perhaps the greatest advantage aside from the heat efficiency is its adaptability for use aboard ship in connection with the lighting plant, on account of the small space occupied. It has been found that a great reduction in use of steam in the turbine results from using superheated steam. The economy of superheated steam was demonstrated years ago in marine practice, but, owing to the type of boiler used aboard ship, advantage could not be readily taken of it. With the tubulous boilers so largely used on land it would be a matter of no difficulty to superheat steam to any desired amount, and thus get an increase of efficiency for ordinary engines similar to that obtained in the steam turbine over saturated steam. If exhaustive, scientific and impartial tests of steam apparatus were made in this country similar to those so extensively carried out by Prof. Kennedy in England, much benefit would undoubtedly result, and new types and ideas would not have to languish for years before their utility becomes recognized.

Pioneer Inventors. MUCH space, more or less valuable, has been, and probably will continue to be, devoted to accounts of "pioneer inventors"—accounts which are usually couched in highly eulogistic terms, sometimes even approaching the hysterical in expression. We use the expression "pioneer inventors" in its paradoxical sense as applied to those who first pointed out or made use of an obvious application that involved no exercise whatever of the inventive faculty. In the few instances in which the names of members of this class are deservedly held in estimation, an analysis will probably show this to be really due to their services in demonstrating the commercial advantages of a certain application and securing its adoption, which is a worthy cause of distinction in itself, though lost sight of. It is not to these, however, we refer particularly, but to the others occasionally discovered who lack this and every other material claim to the consideration asked for them. To particularize, we will suppose that once upon a time a man saw a small electric motor, then very rare, in operation, and noticed that its shaft revolved; he is also aware of the fact that other shafts revolve, and it occurs to him that by hitching a motor to one of these other shafts it will be revolved by the motor. Acting on the thought, he makes a model, perhaps astonishes some of his neighbors, and that is the last of it as far as he is concerned. Many years later, when motors have assumed a commercial form, and are generally employed, the model is brought to light, a journalistic writer gets up an article with many illustrations, including perhaps a portrait, a view of the man's former residence and of his grave; the world's ingratitude to its great inventors is enlarged upon or a quotation from Gray's "Elegy" neatly worked in, and another name is added to the list of pioneer inventors. As another example of the pioneer inventor, the writer was recently informed that the Niagara transmission scheme was really invented years ago, and the ideas there being applied were stolen from the inventor; upon pressing for particulars it was learned that the claim was based on the principle of the generation of electricity from water power, and further inquiry developed that the claim finally rested on the supposed first connection of a dynamo with a turbine shaft. Most of the accounts of pioneer inventors would be merely amusing were it not for the fact that the claims made are eagerly accepted by writers of popular books on account of the supposed interest they will give their narrative, with the consequence that the credit of the real inventor is diminished, or perhaps entirely lost sight of.

That Photograph Controversy. WHEN a person keeps in stock a supply of answers which he intends to use, no matter what contingency may arise, it makes him anxious for that contingency to present itself so that he may use his ammunition before it has taken on the odor of decay. Our contemporary, the "Western Electrician," frets itself beyond measure because it is not attacked or rebuked quite as promptly as it thinks it ought to be. That a week should pass without something severe being said in reply to its vaporings seems to it incomprehensible and especially aggravating since it already has in hand the panacea which, like the usual patent medicine, either cures the disease expected or converts that disease into one that it can cure. We have heard of the itinerant who had but two medicines in his chest—one to give the patient fits and the other to cure fits, for, as he said, he was great on fits. But our esteemed contemporary does not seem to be able to think and write at the same time. It is like the steam yacht which President Lincoln said he once owned, or some of his friends did. It had a boiler seven feet long and a whistle eight feet long, and whenever it wanted to whistle it had to stop its other machinery. We gather from the columns of the "Western Electrician" that the following are the facts as it sees them: The photographer took the picture for the General Electric Company and gave it to the "Western Electrician." The photographer was not venal, because he did not collect pay for the picture from both parties. The photographer was not to blame in any way in the matter, because he did not give the negative to the "Western Electrician." He is further not blamable in any way, because, although the negative was ordered and taken for the General Electric Company, it was not ordered by Lieut. Spencer but by some one else, and that some one else didn't tell him not to give the picture away anyway. It admires the fan sign, and deprecates our criticism of it to such an extent as to repeat that criticism in its editorial columns twice, whereas we gave it but once. The photographic episode was not discreditable to the photographer, because photographs when taken to order do not cost $3—not the size under discussion. THE ELECTRICAL WORLD is venal, because it calls upon Lieut. Spencer, who, it says, never has disavowed the responsibility for the erection of the fan, to state what was done in the photograph matter to prevent a repetition of the offense. Lieut. Spencer has stated to us that he had given positive orders to the photographer that no copies of the photograph in question should be given except on his order. Our contemporary is responsible for the statement that no restrictions whatever were placed upon the photographer. A question of veracity is therefore raised between the two, but in the meantime the "Western Electrician" got the photograph, therefore the photographer is virtuous, the tower is a work of art, the fan is elegant and in good taste, and our contemporary is happy. Turn off the whistle, and let the wheels go round again.

An Illustration of German Methods.

We have received from Mr. Oskar v. Miller, a folio volume, neatly bound in cloth and gilt, and published by the municipal authorities of Stuttgart, Germany, describing in detail several of his alternative projects for a central station in that city. The volume contains over a hundred pages, and includes eight large plates, several of which are colored; it is without doubt the finest specimen of a publication of this kind which has come to our notice, and is an excellent illustration of the thorough way in which such things are done in Germany.

The matter covers two sets of proposals, one for alternating and one for continuous currents, and for each of these complete estimates are given for three alternatives differing chiefly in their sources of power, in all of which, however, water power from a distant source is used. Each system is worked out in detail with estimates of first costs, operating expenses and probable income, thus giving a very good comparison between the various systems. In Germany a contract is not awarded on general principles to the lowest bidder, but other considerations also receive an equal, if not a greater, amount of attention.

Mr. v. Miller, whose position is that of a consulting engineer and contractor, has installed some very important plants in Germany, and was one of those who assisted in promoting the famous Frankfort-Lauffen experiment. After a more thorough examination of this volume we may give an abstract of the more interesting data. The installation is to include a generation of current for lighting, power transmission and electric railway in that city. This set of proposals is one of the first in which the costs are given in detail for the various applications of the current, thus enabling one to obtain the relative costs and to compare their relative importance. It is also of interest as showing that even in quite extended cities the introduction of accumulator sub-stations may be preferable and quite profitable in case there is a small amount of water power at hand.

The International Congress of Electricans.

As the time approaches for the assembling of the World's Congress of Electricians the following items may be of interest. It will be remembered that at the meeting of the Advisory Council held Jan. 17 last, several committees were appointed, and among others a committee to decide upon the number of members that each foreign country should be invited to send to sit in the Chamber of Delegates. Their apportionment was as follows:

Five each for England, France, Germany, Austro-Hungary and the United States.

Three each for Belgium, Italy and Switzerland.

Two each for Norway and Sweden, Holland, Denmark, Russia and Spain.

One each for Portugal, British North America, Australian Colonies, India, Japan, China, Mexico, Brazil, Chili, Peru, and the Argentine Republic, making 55 in all.

Up to the present moment eight of the more important countries have officially responded to the call. We give below the names of the delegates in the order of their official appointments:

England.—W. H. Preece, F. R S.; Prof. W. E. Ayrton, F. R. S.; Prof. S. P. Thompson, D. Sc, F. R. S; Alex. Siemens; Major Cardew, R. E.

France.—M. Mascaret, M. Hospitalier, M. Violle, M. de la Touanne.

Germany will be represented by Dr. H. Von Helmholtz, who requests that the following gentlemen of the Physikalische-Technische Reichsanstalt, of Charlottenburg, be allowed to attend the meetings of the Chamber of Delegates, namely: Dr. Feussner, Dr. Kurlbaum, Dr. Leman, Dr. Lindeck, Dr. Lummer and Dr. Pringsheim.

United States.—Prof. H. A. Rowland, Prof. T. C. Mendenhall, Dr. H. S. Carhart, Prof. Elihu Thomson, Prof. Edward L. Nichols.

Switzerland.—M. le Dr. A. Palaz, M. Thury, M. le Dr. Weber.

Italy.—Prof. Galileo Ferraris.

Mexico.—Señor Don A. M. Chavez.

China.—Mr. Peng Kuang-Yu, Mr. Teng Shen, Mr. Shon Yen.

In addition to the above the following unofficial announcement has been made in regard to Austria: "In response to the invitation extended to it to participate in the Electrical Congress to be held in Chicago the Electrotechnischer Verein of Vienna has appointed the following of its members delegates to represent it at the meetings: Nikola Tesla, A. Prosch, inspector of Austrian State Railways; Ernst Egger, Dr. Johann Sahulka, constructor at the Imperial High School, Vienna; Fred W. Tischendörfer and Joseph Wetzler."

Whether it is intended that five of the last-named gentlemen shall sit in the Chamber of Delegates, or not, we have no means of knowing; this question, as well as the request of Dr. H. von Helmholtz in respect to his confrères and the fact that China has appointed three, whereas only one was requested, will have to be referred to the Committee on Credentials at the opening of the Congress.

About a thousand invitations in all have been sent out and from the number of acceptances that are coming in there is every reason to believe that the Congress will be well attended.

The Society for the Promotion of Engineering Education.

Among the divisions of the Engineering Congress held at Chicago, July 31 to Aug. 4, was one devoted to engineering education—Division E. This branch had its inception and birth just before the congress convened, and therefore was not as extensively known as it otherwise would have been, but nevertheless a large number of papers were read before it.

In order to continue the work thus begun at Chicago, a permanent organization has been effected called the "Society for the Promotion of Engineering Education," with Prof. De Volson Wood, of Stevens Institute of Technology, as president, and Prof. J. B. Johnson, of Washington University, St. Louis, as secretary. Meetings will be held annually for the purpose of reading and discussing papers, which will be afterward published in a volume of transactions. The following papers were read at Chicago, and will form the contents of the first volume: "Present State of Collegiate Engineering Education"—"Mining Engineering," Prof. S. B. Christy, University of California; "Electrical Engineering," Prof. H. S. Carhart, University of Michigan; "Architecture," Prof. N. C. Ricker, University of Illinois; "Mechanical Engineering," the committee in charge of division; "Civil Engineering," the committee in charge of division. "The Ideal Engineering Education," Prof. W. H. Burr, Harvard College; "Maximum and Minimum Mathematics Necessary for an Engineer," Prof. A. N. Talpot, University of Illinois; "Present Favorable and Unfavorable Tendencies in Engineering Education," P. C. Ricketts, Director Rensselaer Polytechnic Institute; "Comparison Between American and European Methods of Engineering Education," Prof. G. F. Swain, Massachusetts Institute of Technology; "Civil Engineering Education," J. A. L. Waddell, Kansas City, Mo.; "Views of Practicing Engineers as to the Methods and Needs of Engineering—Shop and Laboratory Equipment," Prof. R. H. Thurston, Director Sibley College; "Laboratory of Hydraulics at Massachusetts Institute of Technology," Prof. Dwight Porter, Mass. Inst. Technology; "The Use of Engineering Laboratories in the Training of Engineers," Prof. John Goodman, Yorkshire College, Leeds, England; "Practical Laboratory Work," Prof. Thos. Gray, Rose Polytechnic Institute; "Original Research by Students," Prof. R. C. Carpenter, Sibley College; "Field Equipment and Field Practice," Prof. C. D. Jameson, State University of Iowa; "Methods of Training Engineering Students in Technical Literary Work," Prof. M. Merriman, Lehigh University; "Drawing for Engineering Students," Prof. C. D. Denison, University of Michigan; "Vacation Work," Prof. A. E. Burton, Mass. Inst. Technology; "Graduation Theses," Prof. Gaetano Lanza, Mass. Inst. Technology.

Meeting of the Association of Edison Illuminating Companies.

The ninth annual meeting of the Association of Edison Illuminating Companies convened at the Wisconsin State Building at the World's Fair grounds at 2 o'clock p. m. Tuesday, Aug. 8.

Reports were made by the following committees: Executive Committee on the Admission of New Members; Committee on Lightning Protection, by A. E. Kennelly, chairman; Committee on Grounding the Neutral Wire; Committee on Prevention of Damage from Crosses with High-Tension Circuits.

Addresses were made on the condition of the patent litigation and other matters concerning the relations of the illuminating companies and the General Electric Company, by Messrs. S. D. Greene and F. P. Fish. Discussion on these subjects was participated in by numerous members.

By request of the Association, Mr. Luther Stieringer read a paper of great interest entitled "Electrical Engineering at the Fair—What to See and How to See It."

Capt. William Brophy, electrical inspector of the Industrial Mutual Insurance Company, of Boston, was invited to address the Association on "Central Station Fire Insurance," and gave a detailed account of past fire losses in electric light and power stations and suggestions as to the prevention of such losses in future.

Mr. F. E. Barker, chairman of the Board of Gas and Electric Light Commissioners of Massachusetts, was invited to explain to the Association the organization and the results of the work of the board in the exercise of its extraordinary powers. His address was very clear and instructive, and was followed by an animated discussion of the great desirability of securing such legislation as to introduce the same method of control in other States.

The Association having received an invitation to take a ride in the electric launches at 8 p. m. and a ride on the Ferris wheel at 9:30, adjournment was made to 10 o'clock Wednesday morning.

The second session was opened on Wednesday, Aug. 9, at 10 o'clock a. m. by Mr. A. B. Herrick, who read a very practical and important paper, illustrated by numerous diagrams, on "The Central Station Switchboard and Its Adaptation to Different Modes of Distributing Potentials."

Prof. A. E. Kennelly, of the Edison Laboratory, read a paper which elaborates still further his very comprehensive paper first read before the Association at the Niagara Falls meeting in 1889 on "The Heating of Electrical Conductors," which has become a classic in electrical literature. The present paper is entitled "The Heating of Cables in Air, Water and Soil."

Mr. C. E. Carpenter was invited to exhibit and explain the peculiar construction of some patterns of rheostats which have recently been adopted by the General Electric Company. The discussion on this subject was unusually interesting, and was participated in by S. D. Greene, Captain Brophy and others.

At the third session, commencing at 2 p. m., Mr. W. S. Barstow, of Brooklyn, N. Y., submitted a paper on "Description and Test of the Third District Station of the Edison Electric Illuminating Company, of Brooklyn."

The election of officers for the ensuing year resulted in the choice of the following gentlemen: C. L. Edgar, president; G. H. Finn, vice-president; W. S. Barstow, secretary; Wilson S. Howell, treasurer; John I. Beggs, chairman; F. P. Gilbert, E. R. Weeks, Wm. D. Marks, J. W. Pryor, C. L. Edgar (ex-officio).

The retiring officers were thanked by vote of the Association, which then adjourned to meet in Boston on the second Tuesday of August, 1894.

The secretary was instructed to prepare and incorporate in the minutes a resume of the laws of Massachusetts creating the Board of Gas and Electric Light Commissioners and a statement of the work accomplished by them, as suggestive of favorable features applicable to other States.

The following representatives were present:

General Electric Company—S. Dana Greene, assistant general manager; F. P. Fish, legal department; A. E. Kennelly, consulting electrician, Edison laboratory; A. D. Page, F. E. Jackson, Wilson S. Howell, John W. Howell, lamp department; Chas. B. Davis, assistant manager lighting department; W. J. Jenks, patent department; Albert B. Herrick, electrician, Schenectady works. Edison Electric Illuminating Company, of New York—James W. Pryor, secretary. Harrisburg (Pa.) Electric Company—John I. Beggs. Renovo Edison Light, Heat and Power Company—J. H. Sheddy, general manager. Edison Electric Light and Power Company, Little Rock, Ark.—G. H. Van Etten, president; J. A. Van Etten, manager; Leigh Carroll, stockholder. Edison Illuminating Company, Detroit, Mich.—C. P. Gilbert, secretary and manager; Hoyt Post, director and attorney. Edison Electric Illuminating Company, of Boston, Mass.—C. L. Edgar, general manager; J. Otis Wardwell, counsel and clerk; L. Stieringer, stockholder. Edison Light Company, Grand Rapids, Mich.—A. F. Walker, superintendent; Daniel McCoy, president. Appleton Edison Electric Company—A. L. Smith, president. Scranton Illuminating, Heat and Power Company, Scranton, Pa.—Jas. P. Dickinson, vice-president; Fred C. Haud, secretary; J. E. Parrish, superintendent. Edison Electric Light and Power Company, St. Paul, Minn.—Geo. H. Finn, secretary, treasurer and manager. Forest City Electric Light and Power Company, Rockford, Ill.—M. A. Beal, secretary, treasurer and director. Elgin City Railway Company, Elgin, Ill.—Chr. Wustenfeld, manager. Edison Electric Company, of New Orleans, La.—E. L. Bemiss, general manager. Columbus Light and Power Company, Columbus, O.—C. H. Lindenberg, director; A. W. Field, secretary and manager. Edison Electric Light and Power Company, of Kansas City, Mo.—E. R. Weeks, general manager. Des Moines Edison Light Company, of Des Moines, Ia.—J. A. Colby, general manager.

An Invitation to Eastern Members of the International Electrical Congress.

Mr. A. W. Grant, of the Niagara Falls Park & River Railway, has extended an invitation to the Eastern members of the Electrical Congress and their friends to inspect and take a ride over his electric road on Sunday morning, Aug. 20, before the special Congress train proceeds to Chicago. This electric road, operated by Niagara water power, is one of the finest in the world, and for twelve miles runs with all the wonderful scenery of the Niagara Falls and Rapids in full view. The courteous invitation has been accepted on behalf of the party and arrangements have been perfected so that the excursion can be made with ample leisure on Sunday morning after breakfast. The round trip over the electric road will take about two hours, and special cars will be provided for the party.

Transportation to the International Electric Congress.

Arrangements have been perfected with the New York Central & Hudson River Railroad Company for the transportation of delegates to the International Electrical Congress from New York and vicinity on the following schedule:

Leaving Grand Central station 7:30 p. m., Saturday, Aug. 19, the train will arrive at Niagara Falls the following morning for breakfast, where a few hours will be spent in sight-seeing. The journey will be resumed in the afternoon, reaching Chicago early Monday morning, Aug. 21.

The price of the round trip is $42. It is essential that all delegates desiring to join this special party should communicate at once with Mr. C. O. Baker, Jr., 136 Liberty street, New York, stating the number of tickets and space desired in the sleeping cars.

The Economic Operation of Electric Railways.

BY W. F. C. HASSON.

The following is contributed as an addition to the article by Mr. J. B. Cahoon in The Electrical World of July 15:

Some months ago it was decided advisable to increase the service of a certain electric street railway line. The station equipment consisted of three 90-h. p. generators, driven by an engine capable of developing, under favorable circumstances, at least 450, if not 500, h. p.

The president of the road was advised by the engine contractor that, in order to double the service of the main line and to supply a small amount of power for a branch line, additional engine power to the amount of 600 h. p. would be necessary.

A rival contractor, doubting this, asked for an opinion of the additional power necessary. By the direction of the president of the company a number of indicator cards was taken and submitted to me for investigation. However, as the high-pressure cards were taken on one day and the low-pressure cards on the following day, and no switchboard measurements were made, the results were not of particular value to me.

I afterward made a complete set of simultaneous observations and obtained the results given in the accompanying table:

Type of engines, compound, horizontal, direct acting; Corliss valve gear.
Diameter of h. p. cylinder, 22 in. Stroke, 48 in.
Diameter of l. p. cylinder, 40 in. Stroke, 48 in.
Diameter of piston rods, 4 in.
Revolutions per minute, 66.5.
Engines as now operated are non-condensing.
Boilers: Six horizontal, return tubular. Diameter, 60 in. Length, 16 ft. Number in use, 4.
Steam pressure—At boilers, 95 to 100 lbs.; receiver, 17 lbs.

Mean pressure h. p.	Horse power. h. p.	Mean pressure. l. p.	Horse power. l. p.	Total output of engines, horse power.	Electrical output to line, horse power.	Loss, horse power.	Loss, p. cent.
35.76	215.6	2.2	44.3	259.9	197.2	62.7	24.1
35.48	213.9	1.43	28.7	242.6	170.9	71.7	29.5
31.75	191.3	.83	16.7	208 0	144.7	63.3	30.4
24.68	148.6	—.8	—16.1	132.5	84.4	48.1	36.3
30.50	182 8	.37	7 7	190.5	137.5	53.0	27.8
27.62	164.6	—.32	—4.3	160.3	95.0	65.3	40.7
36.55	220.3	1.5	29.9	250.2	177.3	72.9	29.1
33.68	203.0	.98	19.2	222.2	166.2	56.0	25.2
31.65	190.5	.71	14.2	204.7	141.2	60.5	29.5
Aver. 31.95	192.4	.73	15.6	207.9	146.4	61.5	29.5
Frict'n Card. 16.05	102.6	—2.81	—59.76	42.84	———	42.84	100.0

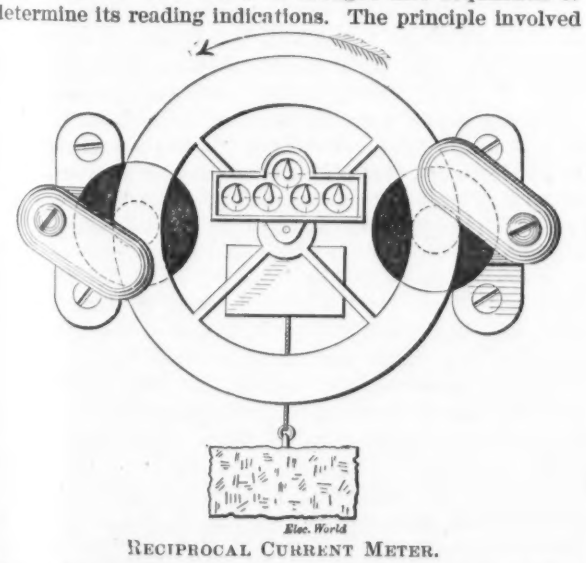
The directors of this company, at the time of the selection and installation of the plant, considered the advice of an independent engineer as unnecessary. They now consider such advice interesting, if no financial consideration is attached to it.

Further comment on the data given would be superflous.

Suggestions for Metering Devices.—VI.*

BY S. D. MOTT.

I send you herewith drawing of an electro-mechanical device, which may appropriately be called a reciprocal current meter, inasmuch as reciprocal proportion or the single rule of three must be brought into requisition to determine its reading indications. The principle involved



RECIPROCAL CURRENT METER.

is one that could be adapted to certain kinds of laboratory work, when exceptional accuracy was not imperative, requiring no particular skill to construct, and when it is desired to avoid delicate manipulation and adjustments.

It consists of the familiar Foucault disc, mounted in bearings on a frictionless spindle, and actuated by the constant pull of any form of potential energy, together with magnets so disposed as to cause a retardation of the same.

A stop arrangement actuated by the magnet to stop the movement of the combination when no current circulates is a necessary adjunct not necessary to describe here. A flyer may also be used to give constant resistance to motion.

As is well known, any conducting material moved either by rotation or translation in certain directions in the field of force of a magnet will be held back, retarded in its movement, by the magnet in proportion to the energizing current, owing to the eddy or Foucault currents set up therein. In the case illustrated we have a metallic disc rotated on an axis by a constant force and disposed in the fields of a pair of magnets whose energizing current is to be measured. The greater the quantity of electricity passing on the line the greater is the resistance to the revolution of the disc and the less will be the indications on the registering dial. The counter or dial summarizes in arbitrary units this varying speed per unit of time.

The maximum capacity of this instrument as shown by the dials is, for instance, 100,000 revolutions, which are standardized to record the flow of one unit of current. As the units are increased by translating devices in the consumption circuit or by any increased output of current the index hands of the meter diminish in speed in a uniform proportion, so that if 100 units give 100,000 revolutions 200 units should give 50,000 revolutions. Or, reversing the proportion, if 100,000 revolutions indicate a flow of 100 units, then 50,000 revolutions should indicate a circulation of 200 units, etc. For instance, divide the reading of the dials at any time into the maximum reading (100,000) and the answer will be the units consumed.

For example, if the register shows 5,825, then 5,825 : 1 : : 100,000 : (x), i. e., x = 17.11 + units consumed.

A Novel Application of Electric Door Openers.

BY GEORGE D. SHEPARDSON.

During a recent visit to his native town, the writer found a novel application of an electric door opener that may be of some interest to others. Granville is a village of about 1,300 inhabitants, situated near the geographical centre of Ohio, and well known as the seat of Denison University, Shepardson College, and Granvillel Female College. The village is connected with the county seat, seven miles distant, by the Newark & Granville Electric ailway, which runs 20 trains daily between the two places. Granville is supplied with its own municipal arc light plant and an excellent water-works system. The water reservoir is on a high hill on the university campus, and gives a pressure of about 85 pounds per square inch, enough to throw a stream over the highest buildings in town. A volunteer hose company has been organized for a number of years, and a room on the ground floor of the Opera House has been fitted up for the hose cart and its equipment. Fires are so infrequent that the hose-cart is seldom touched except for drill. The door of the room is kept locked in order to keep out boys and tramps. The fire-bell rope hangs outside the Opera House door, so that whoever is nearest can ring the alarm when a fire is discovered. The next man on the ground runs out the hose cart. It was usually easier to break the lock or door than to find the key at a time when seconds mean dollars, and it was a problem of some importance to devise a scheme for keeping the door locked in times of safety but opened in time of fire. The question was referred to Prof. A. D. Cole, of the Department of Physics and Chemistry at the University, who designed and put in an ingenious device that works to perfection.

DIAGRAM OF CIRCUITS.

He removed from one of the double doors the plate into which the bolt of the lock enters, and substituted an electric door opener of a type common on the market. This, when in place, looks like an ordinary striking plate, except that the part against which the bolt of the lock strikes is a separate piece hinged and held in position by an iron pin. An electromagnet set further back is arranged to pull this pin and allow the pivoted piece to swing so that the door may be opened although the bolt of the lock is still projecting.

Prof. Cole substituted this device for the strike plate on one of the double doors, and carried the wires from it along the door and flexibly connected them by means of pencil coils on the door jamb to a battery of four cells. A push button near the door affords a ready means of testing the device. Wires from the battery and the door opener are carried through the building and up to the bell, where they connect with two curved brass springs arranged so that the downward movement of the alarm hammer will bring them into contact. At the first stroke of the alarm the circuit is closed, the electromagnet pulls the pin and unlocks the door, which remains unlocked until opened and shut again. The circuits may be traced by the accompanying diagram. It would seem that some labor might have been saved by connecting one wire to the bell and the other to the hammer, since the latter is hung on the wooden framing and so insulated from the bell.

Practical Aspects of Low Frequency Electrical Resonance.—IV.*

BY M. I. PUPIN.

By working with high frequencies and small ohmic resistance any voltage within practical limits can be obtained. Ohmic resistance, however, is not the only thing which limits the resonant rise of potential. Dielectric

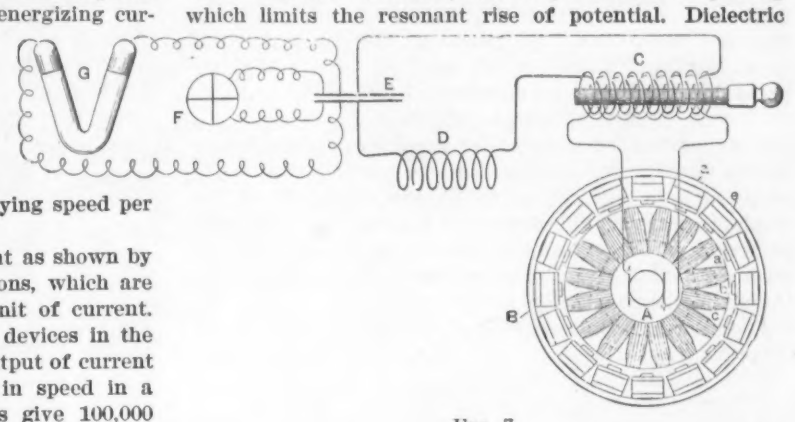


FIG. 7.

hysteresis and the peculiar behavior of iron when under the inductive action of a rapidly alternating current modify this rise very much. The other day I employed this home-made condenser in parallel with that Marshall mica condenser. I obtained only 2,000 volts rise, whereas preliminary calculation led me to expect at least 4,000 volts. But the smell of melting wax reminded me forcibly of the cause of this discrepancy. The home-made condenser got so hot in about two minutes that all the wax (which when boiling hot was compressed between its mica plates to drive out the air and moisture) between its plates was melted. The energy which was thus used up in overcoming the dielectric hysteresis of the wax had prevented the resonant rise from reaching that value which it ought to have reached according to calculation. Taking this condenser out and using the mica condenser alone the rise went right up to a point considerably above 3,000 v. Paraffine and glass behave in a similar way. So that owing to dielectric hysteresis alone the resonant current) which takes place when capacity and self-induction neutralize each other) is never equal to the electromotive force divided by the ohmic resistance, and it can be very much less. The presence of iron is incomparably more powerful in destroying the resonant rise of current and potential, as will be seen presently. This is very unfortunate in view of the brilliant expectations which not a few electricians hoped to realize from the employment of condensers with alternating current machinery.

It is well to observe here that if we substitute a Weston voltmeter for the Thomson electrostatic voltmeter, f, Fig. 7, then we shall have practically the condenser in parallel with the inertia coils. It is easy to see from purely theoretical considerations that the resonant rise will be less in this case. Experiments show that the rise can be then very much less if the resistance of the voltmeter circuit is reduced. The bearing of this observation

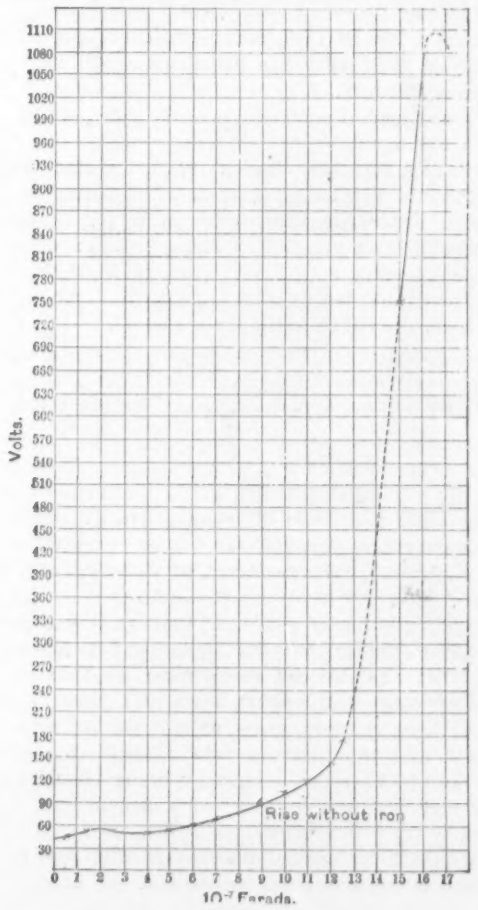


FIG. 9.

on the so-called Ferranti effect with and without a load in the main needs, I venture to suggest, no further discussion.

7. *Effect of Iron on the Resonant Rise of Potential.*—I have already remarked that iron behaves in a peculiar manner when under the inductive action of a resonant flow of electricity. Allow me to call your attention to

* For parts I., II., III., IV. and V. see The Electrical World of 1893. 14, 1893, p. 26; Jan. 28, 1893, p. 63; Feb. 11, 1893, p. 105; March 4, Jan, p. 162; March 25, 1893, p. 228.

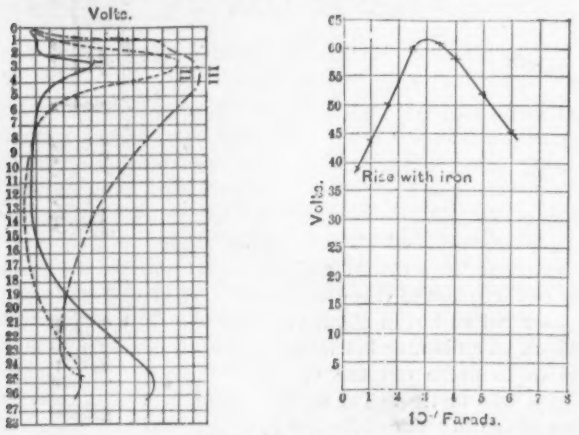
* For the preceding sections of this paper see The Electrical World of July 29, August 5 and August 12.

the diagram of Fig. 9. This curve was obtained with the machine and the circuits which are given in Fig. 7, except that the inertia coil d had smaller self-induction. Keeping the speed of the machine and the self-induction of the circuits constant, the difference of potential in the condenser was varied by varying gradually the capacity of the condenser. Taking, then, the capacities for abcissae and the corresponding voltmeter readings for ordinates, the curve in Fig. 9 was obtained. As you see, the curve has two maxima. The corresponding capacities are to each other as 1:9. Hence the impressed E. M. F. can be represented by

$$E = E_1 \sin pt + E_3 \sin 3\,pt.$$

A comparison of the smaller maximum to the larger shows that E_3, the amplitude of the upper harmonic, is very small in comparison to E_1, the amplitude of the fundamental. This is surprising because, from the construction of the alternator, one would expect a much stronger deviation of the impressed E. M. F. curve from the simple harmonic.

A similar harmonic analysis of the impressed E. M. F.



Figs. 10 and 11.

obtained by means of the electrodynamic interrupter gave curves I., II.. and III., Fig. 10. Curve I. was obtained by inserting a certain capacity in shunt with the primary coil, and then varying the capacity in the secondary and recording the corresponding voltmeter reading. Capacity was measured off as abscissa, and the corresponding voltmeter reading as ordinate. Curves II. and III. were obtained in the same way, but with different capacities in the primary circuit. The impressed E. M. F. in each case can be represented by the following complex harmonic:

$$E = E_1\, pt + E_3 \text{ in } 3\,pt + E_5 \sin_5 pt.$$

But the amplitudes E_1, E_3 and E_5 are different in each case. You see, therefore, that this method of harmonic analysis by the resonant rise of potential is very sensitive in detecting upper harmonics. Hence the natural conclusion that curve Fig. 9 indicates no strongly developed harmonics, simply because they were not present. Yet it is very difficult to suppose that my alternator generates practically a simple harmonic E. M. F. when one considers the shape of its armature core. The armature core was a Crocker-Wheeler tooth armature. This point evidently deserved additional investigation.

I inserted a few iron wires into the inertia coil d, Fig. 7, and found that the upper harmonic, weak as it was, disappeared entirely. The iron wires became hot in a very short time. I suspected that iron, when subjected to strong magnetization, wipes out the upper harmonics in a resonant circuit. With the electro-dynamic interrupter the magnetization of the iron cores is very weak, hence the persistence of upper harmonics. This suspicion was verified in subsequent experiments.

When the inertia coil d was packed with iron wire then the resonant rise was very much diminished, as is evident from the curve in diagram Fig. 11.

(To be continued.)

Patent Litigation Regarding Transformers.

(From Our Special Correspondent in Budapest.)

An interesting patent litigation has recently been decided in the city of Tours, France, in which the electric lighting station made use of ironclad transformers and ran transformers in parallel; the former was claimed to be covered by the French patent of Zipernowsky, Deri and Blathy, and the latter by that of Zipernowsky and Deri. After a number of years of litigation it was decided by the three experts, Messrs. Fribourg, Jousselin and Parville, that the devices used were covered by the above patents dated March 20, 1885, and April 21, 1885, and that these patents were valid. The opinion was unanimous, and the decision was against the infringing company in every respect, they being charged with the costs and with the payment of a certain sum to the inventors.

The decision is of special interest in this city, which is the home of these well known inventors. As the practice of connecting accumulators in parallel is almost universal, and as all transformers, except the hedgehog, are practically ironclad, this decision appears to cover a very large field, and gives these inventors practically the control of the whole alternating field, in France at least; what its effect in other countries will be remains to be seen. These well known inventors were among the first who introduced alternating current systems, and who have since that time been among the hardest workers in this rapidly growing field.

Quartz Fibres and Rods: How to Make and How to Use Them.*—II.

BY EDWIN F. NORTHUP.

The second process for making quartz fibres is similar to that employed in spinning glass threads. Any wheel which is 3 feet or more in diameter and 4 inches or more wide on its circumference, and which can be driven smoothly at a high speed, will answer for a reel. I have used the pulley wheel on a high-speed motor, although that is rather too small.

First cover the circumference of the wheel with smooth black paper. Put the paper on so that when it is cut across in a line parallel to the axis of the wheel it may be unwrapped from the circumference and removed. Paste a strip of flypaper 1 inch wide, with the sticky side up, across the paper wrapped around the circumference of the wheel, so that the fly paper is in a line with the axis of the wheel. Thus with each revolution of the wheel the fibre being wound upon the circumference of the wheel will cross the fly paper and become fastened at that point. Next prepare a quartz rod about 3-16 to ¼ inch in diameter and as long as possible. Fasten this to the end of a brass rod. Place the oxyhydrogen flame about 3 or 4 feet from the revolving wheel and in its plane. A screen about three-quarters the height of the wheel should be placed between it and the flame, and close to the wheel to prevent the wind which the rapidly revolving wheel creates from blowing the flame. The brass rod, with the quartz rod secured to its end, should be rested upon a block of wood of the proper height, so that the quartz rod may be fed into the oxyhydrogen flame. It will probably take two persons to manage the whole operation. When the end of the quartz rod becomes thoroughly fused another rod of quartz, which is held in a pair of pliers, should be brought in contact with the fused end, and a fine fibre should be quickly drawn out and carried over the rapidly revolving wheel. The fibre will be caught by the fly paper and break off between the wheel and piece of quartz held in the pliers. If now everything has been properly managed the fibre will continue to be drawn out and wound upon the wheel exactly the same as in glass spinning. In this way thousands of feet of the finest fibre may be wound upon the wheel. The main knack is in adjusting the oxyhydrogen jet at the proper place on the quartz rod. If the flame is too far back from the point where the thread is being drawn out the thread will be too coarse; if too near the end of the rod the thread will burn off. Practice alone can show how to arrange this.

After enough fibre has been thus secured the wheel is stopped, and the paper wrapped upon its circumference is cut across with a sharp knife in a line dividing the strip of fly paper, and the black paper with the fibres securely fastened to it is removed from the wheel. This paper, with its fibres, can be put away in a drawer, and the fibres removed from it one at a time as required.

Fine fibre made in this way is equal in quality to that made with an arrow, but coarse fibre seems to be rather brittle and weak. This is probably due to the fact that a coarse fibre has not time to cool off before reaching the circumference of the wheel, and the sudden cooling which it there receives on one side spoils its proper annealing, leaving its molecules in a state of strain like a Rupert's drop. Enough fibres may be made in this way at one time to supply all the galvanometers in the world for years to come.

I would suggest that it appears possible in this way to make out of quartz all the things now made of fine-spun glass, and as quartz may be drawn out much finer than glass and being much stronger, it does not appear impossible to make a quartz dress that would rival the most fairylike robes, and be more fireproof than asbestos. In fact, Prof. Langley has already suggested that we may see the day when our wearing apparel will be spun from the granite rocks. I have found that pumice stone is also readily drawn into fibres of extreme fineness, though I have made no experiments upon the tensile strength of such fibres. It is said also that many crystals have the same quality.

The smallest fibre that it is possible to handle, and which will show the iridescent colors, has sufficient tensile strength to hold a light system such as should be used in a Thomson astatic reflecting galvanometer. To suspend such a system proceed as follows: First fasten by means of a very small quantity of the best quality of sealing wax, or a little thick shellac, a very small hook to the system to be suspended, and another hook to the top support. These hooks can scarcely be too small, and the hollow of the hook should form a sharp V, the point of the V being in the same line with the shaft of the hook. Next remove a fibre from the box. To do this first carefully loosen the wax at the end of the fibre from the cardboard with a knife blade, then stand the box nearly perpendicular so that the fibre with the drop of wax on its end will swing free from the box. Pinch two bits of soft beeswax near each other upon the fibre, leaving such a length of fibre below the beeswax as is required. Then break off the fibre between the two pieces of beeswax, and hang up the detached piece upon same support, so that it will hang down free from touching any object. Make the piece of the fibre remaining in the box secure by pressing the beeswax upon its free end against the bottom of the box.

Now measure off the exact length to be used upon the piece of fibre to be used, and mark the spots by touching the fibre with a little shellac. Two very minute hooks like these described above should then be fastened to the fibre. This is best done by first coating the shank of the hook with a thin layer of the best quality of hard sealing wax. Then heat a small soldering iron very hot. Hold the shank of the hook against the fibre at the proper place with a pair of forceps. To do this the hands should rest on a support, and a finger of one hand should be lightly touched against the fibre just below the place where the hook is to be placed against it. An assistant should then bring the hot soldering iron very near to the hook, but not so as to touch it. The wax will melt and fasten the hook securely to the fibre.

When both hooks are on the fibre above and below the hooks may be cut off with the points of a pair of shears. Now hook one hook of the fibre into the upper support hook for the fibre, and fasten the system upon the lower hook. It will be found advisable to touch the place where the hooks come together with a small drop of shellac. The object of this is to prevent the hooks turning upon each other, thus causing sudden and unaccountable movements of the system. When a fibre is thus mounted with hooks it can be very readily removed at any time, and different fibres put into the galvanometer if desired. An extra fine fibre properly mounted on hooks is a treasure, and the pains required to obtain such a one will be rewarded by the galvanometer becoming very sensitive and constant in its action. It is almost needless to remark that for the greatest sensibility a long fibre is required, and Thompson galvanometers of the most improved patterns now provide for a long suspension. It was found that a wax much softer than sealing wax would not answer for fastening the fibres, because they are apt to pull slowly out of the wax, the process not revealing itself, perhaps, for some days after the system has been suspended.

The systems of tangent and ballistic galvanometers are usually quite heavy. Now, if, for example, the system of a tangent galvanometer which weighs seven grains is suspended with a quartz fibre just strong enough to hold it and about 18 inches long, it will be found that the torsion of such a fibre is about double that of a silk fibre which will support the system. The writer had occasion to test this matter very fully, and adopted successfully the following device for obtaining the advantages of both silk and quartz.

Now it is true beyond all doubt that small fibres are very much stronger proportionally to their cross section than large fibres. Further, it is known that torsion increases with the fourth power of the diameter, while tensile strength increases with the second power. Thus both these considerations go to show that the torsion of a rope of fibres with a given total tensile strength will be much less than a single quartz fibre of the same tensile strength. These considerations were fully borne out in some actual experiments made in suspending a large tangent galvanometer system. A quartz rope that readily held the system had no more torsion than the smallest silk fibre that would support the system, while a single quartz fibre barely able to carry the system had more than double the torsion of the silk fibre.

A quartz rope can readily be made thus: Hang up, say, six of the very finest fibres, each with a piece of wax on the free end, and separated from each other by about one-half inch. Then press the finger gently against the row of fibres near the top ends, and fasten them all together by wiping them for a space of about an inch with a little stick covered with shellac. The pieces of wax at the lower end of the fibres will keep about the same strain upon each one. Then fasten the lower ends together in the same way, being careful not to let the fibres get to twisting about each other. Fasten the hooks on the same as in the case of a single fibre. While handling this compound fibre or rope it is well to keep it wet with a little water, so that the fibres will stick together. The heaviest ballistic systems may be suspended in this way with comparatively little torsion.

Rods of quartz about 1-64 of an inch in diameter can be drawn as described, very straight. They are quite strong, and are the best thing I have tried for mounting the magnets of a delicate astatic system upon. They are better than glass because stronger, and far better than aluminium wire, because they never twist after the system is made up, as wire will. Quartz rods may also be used in experiments with static electricity where the very highest insulation is required, C. V. Boys being responsible for the statement that quartz will insulate as well in moist air as glass will in air carefully dried by sulphuric acid.

This paper is only intended to point out some of the practical features in the making and handling of quartz fibres and rods. Those interested especially in the investigations made upon the qualities of quartz fibres can find much material in the "Philosophical Magazine," by C. V. Boys and others.

* For the first section of this article see The Electrical World of August 5, 1893, page 99.

IN ELECTRICITY BUILDING AT THE WORLD'S FAIR

THE FORT WAYNE ELECTRIC COMPANY.

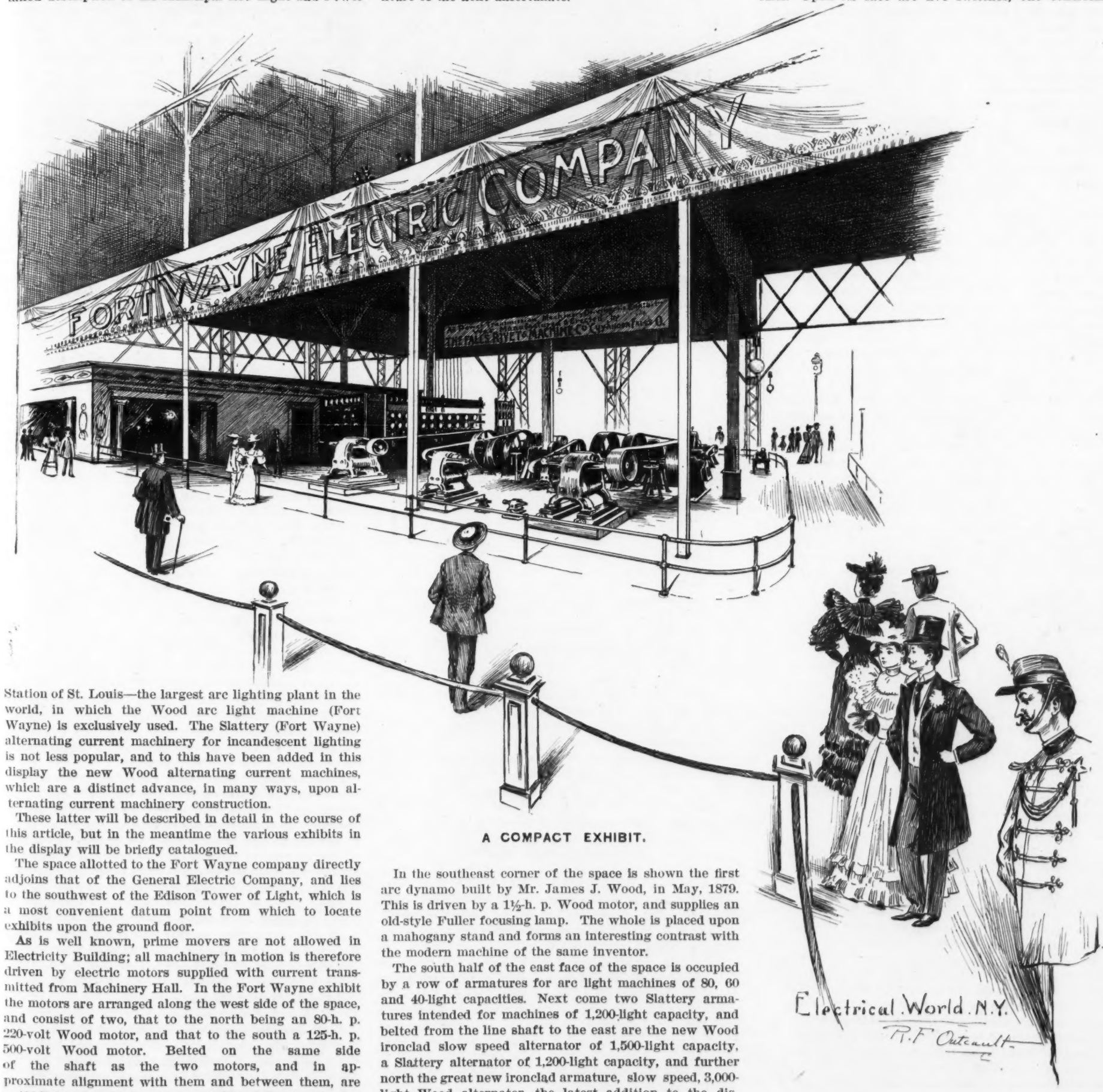
The Fort Wayne Electric Company's display is one of the comparatively few in Electricity Building which is actually in operation and doing commercial work. As is well known, the arc lighting apparatus of the Fort Wayne company is one of the most popular in the market, and is employed in some of the largest lighting stations in this country. Readers of The Electrical World will remember that in the early spring we gave a somewhat detailed description of the Municipal Arc Light and Power Station of St. Louis—the largest arc lighting plant in the world, in which the Wood arc light machine (Fort Wayne) is exclusively used. The Slattery (Fort Wayne) alternating current machinery for incandescent lighting is not less popular, and to this have been added in this display the new Wood alternating current machines, which are a distinct advance, in many ways, upon alternating current machinery construction.

These latter will be described in detail in the course of this article, but in the meantime the various exhibits in the display will be briefly catalogued.

The space allotted to the Fort Wayne company directly adjoins that of the General Electric Company, and lies to the southwest of the Edison Tower of Light, which is a most convenient datum point from which to locate exhibits upon the ground floor.

As is well known, prime movers are not allowed in Electricity Building; all machinery in motion is therefore driven by electric motors supplied with current transmitted from Machinery Hall. In the Fort Wayne exhibit the motors are arranged along the west side of the space, and consist of two, that to the north being an 80-h. p. 220-volt Wood motor, and that to the south a 125-h. p. 500-volt Wood motor. Belted on the same side of the shaft as the two motors, and in approximate alignment with them and between them, are a 400-light 110-volt direct current Wood dynamo, and a 250-light 110-volt dynamo of the same make. Upon the south line of the space is shown a one-light Wood arc dynamo driven direct by a 1½-h. p. Wood motor. This supplies a large locomotive headlight to the east containing an arc focusing lamp.

On a post in the southwest corner, just about the height of a man's head, is stationed a ¼-h. p. Wood motor driving a powerful little fan which has been denominated "The Coney Island Breeze." It runs so noiselessly that the passer-by is scarcely conscious of its presence until his hat is blown off, to the amusement of the groups of lookers-on, who are lying in wait for such catastrophies. The unfortunate victim, with ill-concealed embarrassment, usually picks up his hat and glances around to see who is looking, very much as the man does who has incautiously stepped upon a banana-peel on the sidewalk, and passes on with a good-natured but somewhat sheepish expression, if he be accompanied by a lady, or steps aside, if he be alone, to enjoy the discomfiture of the next unfortunate.



A COMPACT EXHIBIT.

In the southeast corner of the space is shown the first arc dynamo built by Mr. James J. Wood, in May, 1879. This is driven by a 1½-h. p. Wood motor, and supplies an old-style Fuller focusing lamp. The whole is placed upon a mahogany stand and forms an interesting contrast with the modern machine of the same inventor.

The south half of the east face of the space is occupied by a row of armatures for arc light machines of 80, 60 and 40-light capacities. Next come two Slattery armatures intended for machines of 1,200-light capacity, and belted from the line shaft to the east are the new Wood ironclad slow speed alternator of 1,500-light capacity, a Slattery alternator of 1,200-light capacity, and further north the great new ironclad armature, slow speed, 3,000-light Wood alternator, the latest addition to the display.

A 400-light direct current armature and a 160-h. p. generator armature, with two small exciter armatures slung to its shaft, are shown just south of the 3,000-light Wood alternator. To the north of the latter are shown a 60-light and an 80-light Wood arc machine, a search light and a 125-light half-arc Wood machine.

In the centre of the space running east and west is a 12-machine 12-circuit sample switchboard, used here for the distribution of both direct and alternating currents at 110 volts. Adjoining this is a 6-machine 6-circuit arc switchboard of marbleized slate—that is, the front of the board is equipped for that purpose, while the reverse side is equipped as a 2-machine 2-circuit alternating current switchboard, and is used for the control of the circuits from the two alternators in use.

Facing the west and running in a north and south direction is another marbleized slate switchboard for the control of the motor and low-tension direct current circuits. Upon its face are five switches, one controlling the 500-volt motor, one controlling the 220-volt motor, one each for the 400 and 250-light machines, and one for throwing in multiple the two latter. Necessary rheostate, ammeters, voltmeters, fuses, etc., are also found here. Upon the floor at the base of the switchboard are the starting boxes for the two large motors. On the rear are found the connections and automatic circuit breakers for the motor circuits. No lightning arresters are used, but the armatures are protected by means of three sets of fuses between their terminals and the line.

Partly inclosed by and to the north and east of these switchboards is a space devoted to Slattery transformers. This is surrounded by a railing, the top of which serves as a display board for apparatus and parts of apparatus to be referred to later on. There are within this space transformers of the following capacities: 5, 10, 15, 25, 30, 40, 50, 75 and 100 lights, the whole aggregating 2,000 lights. Some of these transformers are in actual operation, but others are idle, being merely displayed to make the series complete. As is well known, the fuses accompanying the Slattery transformer are not inclosed within the transformer itself, but are located outside in a separate compartment, and so arranged that they can be inserted conveniently, and without danger. Both single and double pole fuses are employed.

Upon the railing surrounding the transformers are found the following: Discharge boards for the 500-volt fields, ground detectors for arc and incandescent circuits, fan motors, all kinds of brushes and brush holders, Wood ammeters and voltmeters, arc-light suspension boards, spark arresters for arc lamps, journals for different sizes and types of dynamos, rheostats, commutators for generators and arc machines. And then comes a very thoughtful arrangement, which has a high educational value, namely, a complete set of the parts of a 40-light arc machine regulator, which may be handled at will by those admitted within the railing. Too often has this educational feature been neglected in the displays at the World's Fair, and the only opportunity afforded a student for studying a machine is in its completed and assembled state, which does not always permit of an intelligent examination of all its several parts. But here one has both before his eyes and may study them in detail or assembled, and thus get an intelligent idea of the mechanism of this most essential part of the constant current machine.

When we meet with the endeavor on the part of an exhibitor to afford his visitors an opportunity for study, we feel inclined to assist him all in our power by calling special attention to this feature. This is one of the too few cases where an enlightened policy has been adopted by the exhibitor, and we believe we are doing our readers a genuine kindness in calling especial attention to this display, which is in such marked contrast to the displays of some other exhibitors, and with that policy which has prevented not only the visitors but the electrical press from gaining the information so much desired by every student of electro-technics.

We have no apology for this digression; but to proceed: Just north of the transformer space is a lamp rack containing 84 lamps of the various sizes and styles for alternating, constant potential and constant current arc lamps made by the company. Twenty-four different styles are here represented. The company makes in all 27 different styles, one of those not represented being an arc lamp for street railway circuits to be used nine in series on a 500-volt circuit.

The north side of the space is bounded by a wall, and upon this has been outlined in incandescent lamps the name of the company and its location, namely, Fort Wayne Electric Company, Fort Wayne, Ind. Upon either side of the sign is a panel upon which is painted the coat of arms, on one side of Indiana and on the other of Illinois. Each of these panels is illuminated by six incandescent lamps. The total number of lamps in the sign and panels is 300.

Just below the sign is a series of wooden shelves upon which are shown three designs of alternating current meters; the first is the original folding fan meter, the second the aluminium Arago disc, and the third the new style Wood alternating current meter, the latest production of the shops. These meters are connected in the lamp circuits supplying the lamps on the sign, and are shown in actual operation when the proper switches below are turned on. In addition to these meters there are others of their well known types in the usual metal cases, illustrating the commercial form in which they are supplied to customers.

Entering a small door in the centre of the north wall, just to the west of the lamp sign, one is ushered into the storeroom, which is equipped, in the usual manner of central station storerooms, with all the apparatus and paraphernalia required in maintaining commercial electric circuits. In fact, this display may be regarded as a miniature central station, for it supplies current to all of the exhibitors in the northwest gallery and to about one-half of those in the southwest gallery.

The Office.—But a central station must needs have an office, and this one is no exception to the rule, for it has erected and furnished to the north of its exhibit a most cozy little office where those in charge are glad to meet their friends. The office building is uniform in architecture with those of the offices of the General Electric Company and the Lamp Company which it adjoins, and covers a floor space of 18 by 24 feet. The walls are colored with Indian red, and are pierced by two ample doorways hung with handsome portieres of Turkish material. One of these doorways opens out upon the aisle, and the other upon their exhibition space. The illumination within is entirely artificial, and is supplied chiefly by four arc lamps of 2,000 c. p.

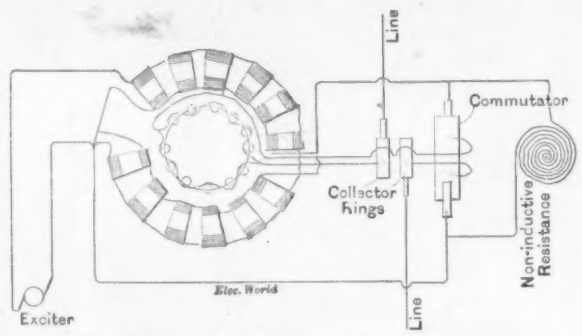
In the centre is a handsome bronze chandelier with six lights, and these are re-enforced by some 25 others distributed around the walls.

The air is kept delightfully cool by five electric fans distributed judiciously around the walls. The inlaid floor of oak is covered with a handsome Turkish rug, upon the centre of which stands an elegantly carved oak table. In one corner is a large office desk and on the other side of the room a handsome sofa or lounge upholstered in tan leather, which, in keeping with the similarly upholstered chairs, adds elegance to this beautiful apartment.

The Wood Arc-Light Dynamo.—As has already been stated in The Electrical World, this interesting machine is of the consequent pole ring armature type, employing two pairs of brushes upon its commutator. The most interesting portion of an arc-light machine is the mechanism by which the current is maintained constant, and that employed by Mr. James J. Wood is one of the most interesting of this class of controlling apparatus.

We have stated that four brushes are used upon the commutator; these are arranged in pairs, and so controlled that the distance between the two brushes of a pair is modified, as well as the line of commutation, as the demands on the circuit are varied.

On one end of the machine is placed a solenoid magnet in series with the line. The pull of the solenoid is normally balanced by a coiled spring, and attached to the end of the solenoid core is a lever which is moved through a vertical plane up or down as the demands on the circuit are varied. Rigidly attached to and concentric with the armature axis is a small pinion which gears into two other pinions of the same size, thus giving them rotation, the first in a direction opposite to the armature and the second a rotation in the same direction. Attached to and revolving with these two latter cog wheels are small friction rollers, which are alternately thrown into contact with an 8½-inch friction wheel, as the lever before mentioned is thrown up or down; thus, if the coil spring overpowers the solenoid and the lever falls, the friction roller revolving in the same direction as the armature is thrown in contact with the large friction pulley, while if the motion of the lever is upward it is thrown away from the friction pulley, and the other friction roller is thrown in contact with the latter, reversing the motion. The motion of the large friction pulley in whichever direction it revolves is communicated by double reduction gear to a small shaft, upon which is located a differential gear, one of which meshes into the shifting apparatus of



The New Wood Ironclad Alternator.

one of each pair of brushes, and the other, meshing into that, shifting the other pair of brushes. In this way the distance between the two brushes of each pair is separately controlled, though their distance apart is always a function of the change of angle of commutation. A simple device is inserted in the train of mechanism to prevent the wearing away of the friction surfaces in case the demands of the circuit should cause too great a change in the line of commutation. This consists simply of a clutch finger by which the regulating apparatus is thrown out of gear when the proper range of shifting of the clutches has been exceeded.

A feature of the solenoid magnet not observable on the machine itself, but shown among the detached parts before referred to, is the means resorted to to prevent the sticking or binding of the solenoid core; it consists simply of inserting in a slot in the inner end of the core a small brass roller, which rolls upon the inner cylindrical surface of the solenoid as the core moves in or out.

New Wood Ironclad Alternator.—This machine, which is one of the most interesting of any exhibited, is worthy of a detailed examination, both because of its novelty of construction and because there is embodied in it a distinct advance in the construction of alternate current generators. As before stated, there are two of these exhibited here, the largest of which, the 3,000 lighter, has only just been erected, and will serve as our model. In this there are 24 fields, and the armature has the same number of coils. In the construction of this machine it has been the endeavor to reduce as much as possible the amount of material and at the same time to keep the speed within reasonable limits. In the construction of the armature, which is of the ironclad type, the coils are all carefully inclosed in mica ducts 1-16th of an inch in thickness, and set well below the surface, making it impossible under any conditions for the coils to fly out from centrifugal force. The ironclad principle also does away with all bands and other external fastenings tending to become loose or to burst. The insulation of each coil is carefully tested to 5,000 volts between the coil and core before the armature is placed in the machine for final test. The attempt has also been made to reduce the number of turns per coil for the potential required to the minimum, while at the same time keeping the armature induction at the highest practical point. The marvelous result has been obtained of one volt for 3.6 inches of conductor on the armature, which is something heretofore unheard of. These figures are given on the authority of Mr. James J. Wood, the electrician and general superintendent of the Fort Wayne Electric Company, and the inventor of the machine.

The armature core is of peculiar construction. It is not built up of rings or segments, as has been the usual custom, but is built up of C-shaped stampings which are put together in a somewhat similar manner to the pieces of link belt, differing in this, however, that they do not correctly register, the one with the other, but leave air spaces, not only between every set of punchings, but also air ducts around the active coils, which air ducts or channels are formed by the failure of the punchings to register when assembled in the complete armature. This construction gives an enormous radiating surface, which in this machine is equal to about 40 times the actual surface of the armature, and as the armature revolves the powerful draughts of air created are forced through these channels, rendering it almost impossible for it to become overheated, even though running on an overload for a considerable period of time.

Referring to the diagram, the connections of the armature are seen to be exceedingly simple. In this machine the coils are connected in multiple series, one end of the coils being connected to one of the collecting rings, while the other end of the coil is connected to one of the commutator segments; the other commutator segment and other rings being connected together, as shown. The machine is compound wound, the series excitement being due to the current from a small separate exciter, which passes around all twelve fields in series. The compounding, which does not differ materially from the method employed in the Thomson-Houston machine, is best explained by reference to the diagram.

It will be seen that a portion of the armature current is rectified by the commutator, after having passed through a non-inductive resistance, shown diagramatically to the right. This rectified current thence passes around the field coils in order to produce constant potential or over compounding in the external circuit, as may be required. Each field is wound with four layers of wire, the first two layers being supplied by current from the exciter, and the two outside layers being supplied by the commutated current. The main excitation is, of course, produced by the separate exciter referred to. This machine is also of the slow-speed type with ironclad armature and gives practically constant potential without compounding on all changes of load. It has a maximum capacity of double the output required by the alternator, which it accompanies.

The yoke construction on this dynamo is also a new departure, the yokes being made somewhat less than half circles, and placed below the centre of the shaft and adjusted from an independent pedestal. The advantage of this arrangement is that it permits the removal of the armature without disconnecting the yokes, brush holders or connections, thus effecting a great saving in time, should it become necessary to remove the armature at any time.

The field magnets are constructed with slotted poles in order to prevent eddy or Foucault currents, and are well ventilated by the currents of air blown across their faces from the armature.

The field shunt or non-inductive resistance, as it has been called, which is used to regulate the over compounding, is mounted in the pedestal, as before stated, on the commutator end, and ventilated by a forced draught from the armature. It is thus not only kept cool but is also protected from metallic dust or mechanical injury. This pedestal has a perforated door which can be removed should it become necessary, from any cause, to alter the adjustment of the shunt.

There is also a sliding base accompanying this alternator, which not only enables the attendant to move the dynamo in order to tighten or loosen the belt, but at the same time to move the exciter, so that the tension of the exciter belt is not altered in changes of position of the alternator. This is a very convenient improvement, as it enables this part of the work to be done by one man, instead of two, by the movement of a single lever.

On the commutator two sets of brushes are used on each side in multiple, so that one set can be removed for trimming, while the machine is in operation. On the collecting rings of the large alternators two sets of brushes are used in tandem, so as to give increased carrying capacity for the large currents the alternator is intended to furnish.

These machines are built in sizes of 750 and 1,500 lights for what is called the first type, and 3,000 and 6,000 lights for the second type, and for 1,000 or 2,000 volts, as may be required. They are over compounded for from 5 to 10 per cent. loss.

A comparison of the new machine with the old Wood alternator of the same capacity will be of interest here. The new alternator runs 350 revolutions per minute slower, has 1,000 pounds less copper on it, and weighs, complete, 6,500 pounds less.

The new machine has already attracted wide attention among visiting electricians, and it is destined to attract still more when the extraordinary claims made for it become better known.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY.

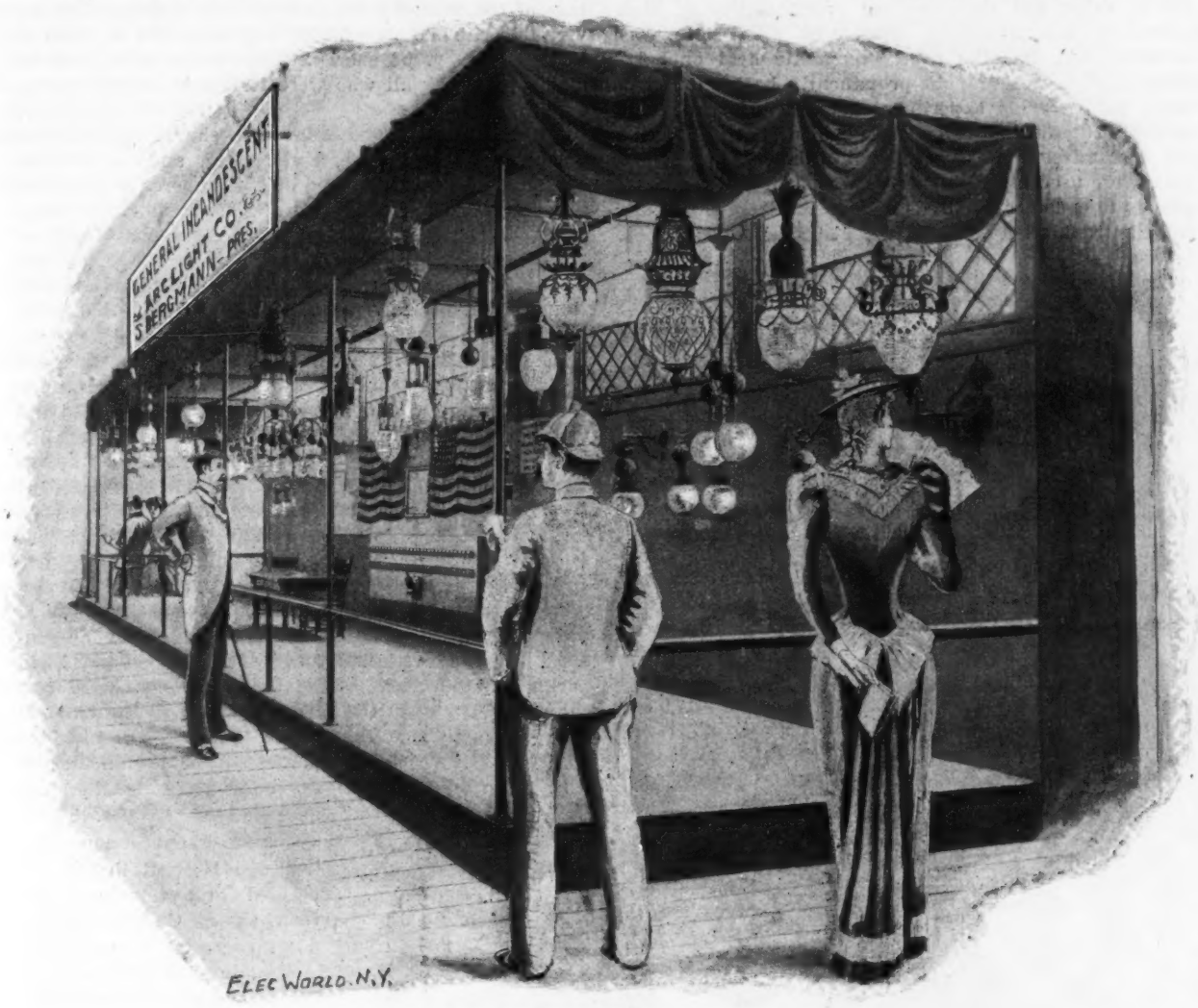
One of the pleasantest displays in the Electricity Building is that of the arc lamps and arc lamp fixtures to be found in Section 3, Space 6, which lies along the northeast wall of the building, occupying an area of 68 feet by 13 feet. Shaded by a canopy of the Spanish colors, supported by a light framework of gas pipe tubing, there are here displayed the wares of the General Incandescent Arc Light Company, already well known and popular in the market.

On the centre of the wall is a row of simple switches and cut-outs for 30 circuits. Distributed along the walls are handsome brackets in gold, iron, polished steel and matt finish, and pendent from the canopy above are single lamps and clusters of lamps, both for indoor and outdoor lighting. As is well known the lamps of this company are intended chiefly for incandescent or constant potential circuits, and therefore find use more especially for interior illumination. The situations which these lamps are called upon to fill has made a demand for some qualities not so essential for outdoor illumination; namely, great steadiness of light, ornamental appearance, and smallness of compass. As they are called upon also to compete in a sense with the incandescent lamp, they have carried the sub-division of the light to a much finer point than is called for in outside illumination.

All of these details have been given special attention by the company, and there are exhibited in this display Standard or Rack Feed lamps, "regular," "short," and "long," the Chain lamps, "regular," "short," and "long," and the Bijou lamps, "regular" and "short," consuming 4, 6, 8 and 10 amperes. Of the rack feed lamps, those termed "regular" have a length of 43 inches, and have a life of from 10 to 11 hours. The "short" lamps are 35 inches in length, with seven to eight hours life, and the "long" are 51 inches with 13 to 14 hours life.

In order to adapt the lamps to low ceilings or other situations where length is objectionable, the chain lamps have been introduced, in the mechanism of which a chain and drum are substituted for the rack and pinion. Of these the "short" are 30 inches in length, and have a life of from seven to eight hours, and the "regular" are 34 inches in length, with a life of from 10 to 11 hours. The Bijou lamp is a smaller lamp of the chain mechanism type, especially adapted for decorative purposes, and appropriate for hotels, halls and theatres, as well as the better class of private residences. These are furnished in electroliers, standards or brackets, of two, four, six or more lamps, and are furnished of almost any desired candle-power from 200 up. These are divided into "short" and "regular" lengths, the "short" lamp being 27 inches in length, having a life of from seven to eight hours, and the "regular," 31 inches in length, with a life of from 10 to 11 hours.

The arc lamp was not, in its early days, a thing of beauty, and the manufacturers paid little attention to their ornamentation, feeling perhaps that they were more for use than ornament, and incapable of taking on artistic shapes. The Germans, however, taught us a lesson in this at the Frankfort Exposition, and it was a matter of considerable remark that they far surpassed American manufactures in the decorative side of their work, and that this constituted the chief superiority observable in the arc lamps of their display. This lesson has not been lost upon the General Incandescent Arc Light Company, for they have here displayed samples of lamps and fixtures unsurpassed from the artistic point of view by any previous displays, and have shown in their brackets and chandeliers of Bijou lamps how the soft mellow light of the low ampere arc may be employed to lend beauty as well as brilliancy to interiors of limited or larger extent. The handsomest single piece exhibited is a six-light chandelier suitable for a banquet hall or large drawing room, so elegant is it in its appointments. The globes are porcelain glass upon which opalescent tints play, and the quality of the light radiated from its surface is in keeping with the artistic metal work and graceful design of the fixture itself.



INCANDESCENT ARC LAMPS.

The controlling mechanism of these lamps is exceedingly simple. The feed is by gravity, which is arrested by a pawl and ratchet movement, controlled by an electromagnet in the shunt circuit. The normal position of the carbons is not, as is usual, one of contact between the points, for, upon trimming the lamp and bringing the two carbons into contact, they spring back a distance of about one-eighth of an inch, where they are maintained until an abnormal current passing through the shunt circuit, by actuating the electromagnet, frees the pawl from its ratchet, and the positive carbon descends into contact with the negative, thus establishing the circuit. The moment the flow of current is thus diverted from the shunt the positive carbon springs back again to a distance of about one-eighth of an inch, as above stated, and the arc is established. It is in its former position, and in this position it remains until by the burning away of the carbons the resistance of the arc becomes sufficient to abnormally increase the flow through the shunt again, which again causes the feed mechanism to operate. This exceedingly simple method of feed is adopted in both the rack and chain lamps, the only essential difference being that in the chain lamps the descent of the carbon winds up a spring within the chain pulley, whereas in the rack lamp these are replaced by a rack and pinion.

The carbons used by this company are of two qualities; the first bear the brand of the Fabrik Elektrischer Beleuchtungs Kohlen of Nurnberg, Germany, and the second is of the best selected domestic manufacture. The positive carbons of both grades are cored carbons and the negative solid. There is a difference of 20 per cent. in price in favor of the American carbons, but it is claimed that there is an equal difference in light and life in favor of the German carbons, and that they are more uniform and cleaner, which makes a balance in favor of the higher priced products.

Although this company has succeeded in making its lamps operate with perfect satisfaction, three in a series on 110 volts, which has not been accomplished before, and in this case the voltage of the arc of the three-ampere lamps is 34, and of the five-ampere lamps, 35, still the usual practice is to connect up the standard lamps two in a series across circuits of about 110 volts. When thus connected the following data are standard for lamps consuming the following currents:

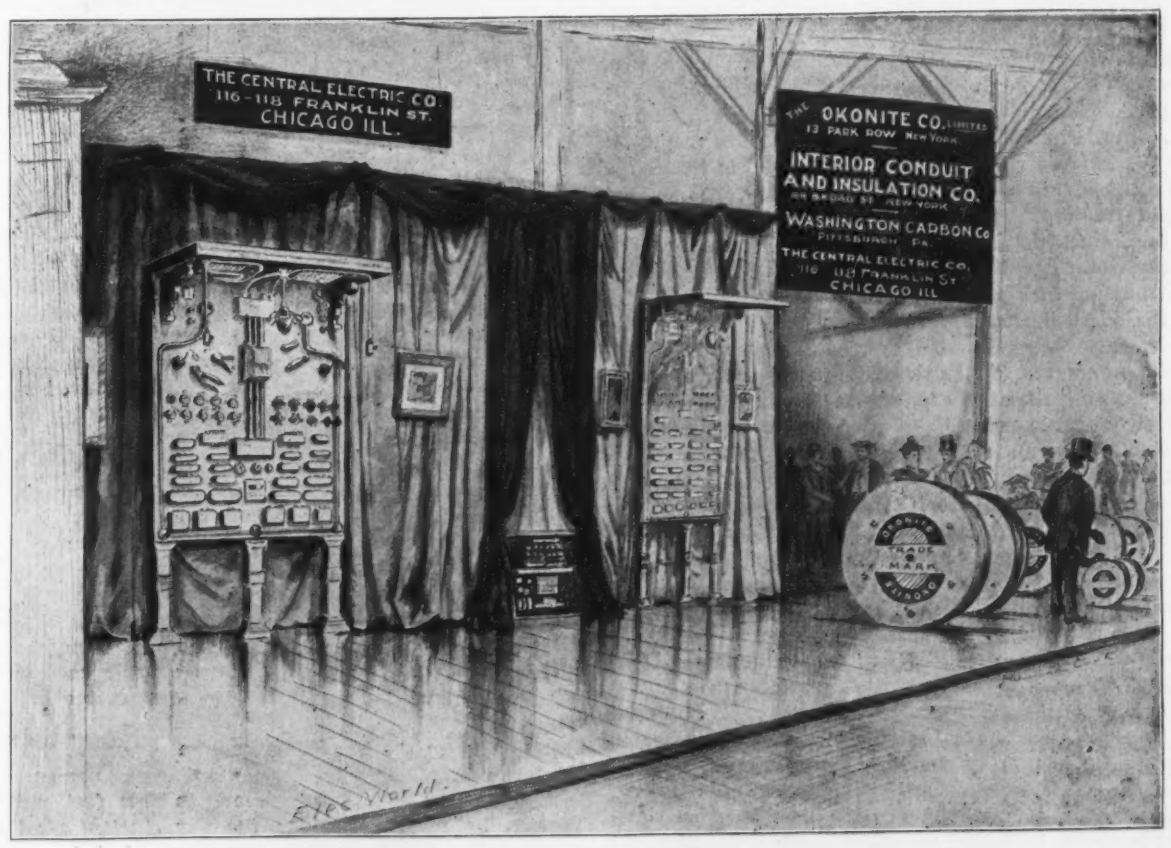
Amperes.	Difference of potential at arc.	Difference of potential between binding posts.
4	41	58-59
6	42	58-59
8	43	58-59
10	44	58-59

The shunt circuit in all styles of these lamps has a resistance of from 440 to 480 ohms.

Where a larger number of lamps are placed in series on a constant potential curcuit, the lamps are provided with an extra resistance, which is thrown into circuit by an automatic cut-out upon the failure of an individual lamp to operate, thus providing, as in constant current lamps, for continuous burning of the remainder of those in circuit.

It should be stated that where lamps are connected across 110-volt circuits, two in series, since each lamp requires but from 41 to 44 volts for its proper operation, an additional resistance is necessarily introduced. In fact, this additional resistance is an essential to the operation of the feed mechanism. It may be placed either in the fixture itself, or at any convenient point at a distance from the lamp; both plans are adopted by this company.

There are 70 lamps exhibited altogether, all of which are provided with insulated hangers, and the insulation is carried throughout the frame so that not only the mechanism, but the lamp frame is insulated from the lamps themselves.



WIRES, CONDUITS AND CARBONS.

THE CENTRAL ELECTRIC COMPANY'S EXHIBIT.

In the southwest gallery of the Electricity Building is a large black signboard with letters in gilt, which

gives an idea of the scope of the Central Electric Company's exhibit. These letters read as follows:

THE OKONITE COMPANY, LIMITED,
13 Park Row, New York.
THE INTERIOR CONDUIT AND INSULATION COMPANY,
44 Broad street, New York.
THE WASHINGTON CARBON COMPANY,
Pittsburg, Pa.

These are the companies for which the Central Electric Company are general Western agents, which is attested by the further announcement, on their own sign, at the bottom of the board, which reads as follows:

CENTRAL ELECTRIC COMPANY,
General Western Agents, 116-118 Franklin Street, Chicago.

The space allotted to this company is L-shaped, the narrower portion being bounded by a high board partition, and the broader portion extending between the centre and western aisles. In this latter is placed the Okonite exhibit, which consists of a number of large spools of wire as follows: Beginning at the north is a reel of 500,000 circular mils Okonite braided cable composed of one strand of No. 14 and 117 of No. 16 B. W. G. wire. Adjoining this is an Okonite aerial cable composed of 19 conductors of No. 16 B. W. G. covered with 6-32-inch ex. standard covering. Next comes a No. 4 A. W. G. stranded Okonite submarine cable, covered with .46 inch insulation. A No. 6 A. W. G. braided solid Okonite wire covered with 30-inch insulation, a 25 straight conductor No. 18 B. W. G. Okonite armored submarine telephone cable with insulation 6-32 inch, and a No. 4 A. W. G. braided stranded Okonite cable with .40-inch insulation occupy the centre, directly underneath the sign.

To the south are found a 7-conductor cable, each composed of three No. 18 B. W. G. wires, with 9-32-inch insulation, armored for submarine use; a reel of aerial telephone cable containing 25 pairs of conductors of No. 18 A. W. G., covered with 4-32 of an inch of the standard covering, and a No. 0 A. W. G. stranded Okonite lead covered cable with .65 insulation. All of these wires are wound upon large wooden spools painted white and bearing the well known trademark of the Okonite Company.

The space south of the Okonite display is the narrower portion of the L before referred to, and use has been made of the partition to display in an attractive manner the other exhibits of the Central Electric Company. The partition itself is draped throughout in Quaker drab enlivened with trimmings of red; against this have been erected two large imitation rosewood sample boards with canopied tops. Between these is a small board of oak, draped in black velvet, upon which are displayed the Washington carbons. Upon the walls, in handsome oak frames, are shown two large photographs of the Okonite factory, exteriors, and four interiors. Upon one of the canopied sample boards before referred to are shown metal cased and plain interior conduits, a four-light hanger with pull cord switch, ceiling rosettes, etc. On the board itself are shown fuses, brass covered interior conduits, also iron covered, both alone and as applied to ammeters. Flush switches, junction boxes and the tools used in fitting the conduits are also displayed here. The two boards referred to are practically duplicates in their fittings and constitute the display of the Interior Conduit and Insulation Company.

The carbon board before referred to shows electric light carbons, round, square, oval and elliptical, of various sizes, both plain and electroplated; carbon brushes and battery carbons of various sizes and shapes are also shown. An interesting display is that of a small piece of the crude material, which forms the basis now of all or nearly all of the better grades of carbon in the market; namely, oil coke, which is the solid residuum obtained from the petroleum refining processes. This material has been selected as the best for electric light carbons, from the fact that it contains less inorganic mineral impurities than any other commercially available carbon. Some very large cylindrical carbons, varying from three to six inches in diameter, are shown both in lengths and in discs, and small pencil carbons such as are used in the Westinghouse circuit breakers and others complete the list of this interesting display.

AN EXHIBIT OF INSULATED WIRES.

A CHARMING AFFAIR.

One of the pleasantest incidents that have thus far transpired in Electricity Building since the opening of the fair was the informal reception given by Herr Rathenau, the general director of the Algemeine Elektricitats Gesellschaft, to 50 or more guests who were invited last Tuesday evening to examine the interesting display of electrical apparatus shown by that company.

This great German house is known wherever the science of electricity is known, but perhaps at this time is more closely associated in the minds of electricians with the epoch making experiment two years ago, of transmitting 300 h. p. from the Falls of the Neckar, at Lauffen, to Frankfort, a distance of about 115 miles. We say epoch making, for the reason not only that many of the supposed possible difficulties in insulating against extremely high voltages were thereby proved not to exist, and therefore the practicability of high potentials not previously considered admissible was demonstrated, but the rotary magnetic field or polyphase system was brought prominently before the electrical public. This experiment furnished for the first time data which opened a new field of possibilities in the transmission of energy, and although but 30,000 volts were used here, its success was such as to lead engineers to consider hundreds of thousands of volts, with as little trepidation as 10,000 volts had been looked upon before.

The Algemeine Elektricitats Gesellschaft constructed the machinery and installed the plant for this most interesting experiment, and for this reason is the name so intimately and so properly associated with the experiment.

Promptly at 6 p. m. the invited guests began to assemble, and shortly after Herr Rathenau mounted a box and addressed himself to an explanation of some of the more notable exhibits. He first called attention to a feature adopted by his company, in the construction of motors and generators of the direct current type, that had not yet found its way to this country, and this was the pole ring—a continuous iron cylinder connecting the pole pieces of the field and enveloping the armature. This, he said, was resorted to to prevent sudden changes of current potential, to which was due much of the troublesome sparking of the commutators. As he spoke a large motor of this construction was thrown into circuit and the audience were invited to note the absence of sparks. He considered the pole ring an advantageous addition to direct current dynamo-electric machinery and recommended its adoption by constructors in this country.

Referring to the Frankfort-Lauffen experiment, Herr Rathenau stated that he had noticed in the papers that a criminal was killed quite recently in New York with a current of 1,500 volts. By the same token 20 men coupled up in series could have been killed by the Lauffen current. He described the system of step-up and step-down transformers adopted in the experiment and pointed out how, by these means, even such potentials as 30,000 volts became safely amenable to control. He is a firm believer in and advocate of the three-phase system, and stated that it was capable of everything of which the direct current was capable, besides much more. Among the advantages he cited the facility of transformation afforded by it and the ability to use with it machinery without commutators or collecting rings. He hoped the jury would examine the motors shown with critical eyes, and announce their defects if any were found.

As souvenirs of the Lauffen experiment, small pieces of the wire which was used in the transmission were distributed among the guests, and, in addition to these, pieces of the fuse wire used were also distributed. This was bare copper wire of about No. 36 B. & S., and although the guests were probably all familiar with the size used from having heard it stated or from having calculated it out for themselves, still it was with feelings of the utmost astonishment that they handled the veritable hairlike wire which had been one of three to carry 300 h. p. of energy. These mementoes will be highly prized by all who were fortunate enough to procure them.

A three-phase motor was then shown in practical operation driving a small generator, and as soon as speed was obtained the load of 150 amperes at 110 volts was thrown on in the shape of several hundred incandescent lamps. Several types of three-phase motors, including duplicates of those used at Frankfort, as well as later designs, were thrown into action, and started, stopped and reversed at will. Several motors directly connected to generators by means of flexible connections were shown. These flexible connections are entirely new to this country and consist of two discs, upon the face of one of which are a series of radial slots and upon the face of the other a similar series of brush-like rays of a number of thicknesses of thin sheet iron, so arranged as to take into the slots on the opposite disc. Considerable play is allowed and the flexibility of the brushes is such as to take up the sudden strains if not too great, or to permit them to slip a cog or two if very excessive. The play between the two discs also permits the motor and generator to work easily, even if perceptibly out of alignment. This form of flexible connection is always employed by the Algemeine Elektricitats Gesellschaft, where the direct connected machines are not upon the same base. When the two are upon the same base, there is no chance of the bearings getting out of alignment, and the solid shaft is therefore adopted.

Moving about among the exhibits, Herr Rathenau explained first this one and then that. Coming to the display of incandescent lamps, he exhibited and distributed samples of the uncarbonized filaments used by his company, which he stated were of collodion. These they had found far superior to bamboo; and then he showed the baked filaments ready for insertion into the lamp bulbs. By what process the collodion was rendered non-explosive was not stated. Collodion, as is well known, is gun cotton (di or tri-nitro-cellulose, which contains in its makeup sufficient oxygen for its own combustion even in a vacuum) dissolved in ether, and the residue after the evaporation of the ether is of the same composition and cannot be carbonized. It is probable that the cellulose is reprecipitated from the solution, in the amorphous state, and that this is what is used for the filament, and that collodion is merely one of the stages of the process of preparation.

A series of electric clocks were next described, which he said were intended to be operated from the regular electric light circuits of the streets and were inserted in the circuit just as lamps were. They were controlled, he said, from the central station without additional wires. He explained that lowering the voltage of the circuits from six to ten volts was all that was required to bring all the clocks into synchronism. This lowering of the voltage was usually done about five o'clock in the morning when its effects upon the lamps in circuit would be least felt. Thus once a day every clock was set exactly right with the astronomical clock, and the only variation possible was that which might result from irregular running in the intervals.

Turning next to an electrometer he paid Prof. Ayrton a very neat and well deserved compliment by saying that both of the meters—the Aron and Thomson—which received the prize at Paris, involved a principle invented by Prof. Ayrton, and this same principle was the one upon which their own meter was constructed. He explained that the principle was that of a clock pendulum—the ball or weight of which was a voltmeter coil vibrating inside of an ammeter coil. The acceleration or retardation was very nearly proportional to the energy. Prof. Ayrton explained that he had corrected the very slight inaccuracy by a device which slightly lengthened the pendulum at each swing. Herr Rathenau called attention to his method of correcting, which consisted simply of the addition of a small fin or vane upon the pendulum, by which its retardation

was slightly increased. He stated that this meter was accurate within four per cent.—two per cent. above or two per cent. below the true. He spoke of the Aron meter being a double clock meter. The one he was describing was a single clock. The retardation, however, was shown by a second dial, whose hand by means of a planetary movement traversed the dial synchronously with the clock hand when there was no retardation, but dissynchronously when the retardation was present. Comparison was made not with another clock in the meter but with the observer's watch.

A photographic potential recorder for lighting circuits, by which a continuous photographic record of the fluctuation of the voltage was made and preserved, was next shown and described, and an electric train annunciator, by which the time of starting of the next train and its destination were announced in the depot was also operated.

A number of electrical cooking utensils were shown in actual operation, and tiny cups of tea electrically brewed by fair hands were passed around. Something more substantial to drink was also provided, but it was not claimed that either the champagne or burgundy was electrically prepared or hypothecated.

Among those present were many electrical celebrities, including nearly all of the jurors of electrical awards, of which the host himself was one of the best known. Among other foreign celebrities present were noticed M. Hospitalier, Prof. Ayrton, Prof. Silvanus Thompson and Mr. Rollins.

The evening was an exceedingly pleasant and profitable one, but it was a subject of deep regret among all that this notable exhibit so interestingly described was not entered for competition by reason of Herr Rathenau's being himself a member of the jury of awards. This fact, however, showed in how high appreciation that gentleman held the position which he had been asked to fill, as he preferred that honor to entering into competition himself.

The Electrical World congratulates the Allgemeine Elektricitats Gesellschaft and Herr Rathenau upon the success of this informal presentation of its exhibit, and felicitates itself upon its good fortune in being one of the number honored by the occasion.

A South African Central Station.

In the spring of 1892 the city council at Capetown (South Africa) decided to undertake a number of public enterprises, among which was the erection of a large electric plant, which alone interests us here. After a loan of £250,000 for this large undertaking had been secured in London, several of the leading electrical companies were requested to send engineers to Capetown.

Those who took part in the competition were three firms from London and Siemens & Halske, Berlin. Preference was shown for one of the three plans submitted by Siemens & Halske. In the first of these, alternating current with transformers had been considered; in the second, a three-wire system with four accumulator substations, and the third, which was awarded the contract, proposed a direct current five-wire system with a primary station 1¼ miles from the centre of the city, and an accumulator sub-station in the city itself.

This last-mentioned plan, although not the cheapest, was accepted because the contracting firm could recommend it most highly, on account of its experience with central stations in Wien-Neubad, Wien-Mariahilf, Wien-Leopoldstadt and Trient, and also because the Lord Mayor of Capetown had convinced himself of the actual advantages of this system at several of the above mentioned places.

As motive power for the central station, the very constant and reliable water power of the Tessina brook on Table Mountain was available. A pressure pipe line about 4.5 miles in length, by which a fall of 1,350 feet is made useful, carries the water to the turbines at the central station. Of these there are two with horizontal axes, each coupled directly with a direct current dynamo (interior pole machines of Siemens & Halske) of about 135,000 watts, or about 200 effective horse-power at 250 revolutions per minute. Reserve steam power is contemplated.

The current generated by the dynamos is carried over a 7,019-foot line of 2 by 95 square millimetres copper section iron armored Siemens patent lead double cable, which leads to the accumulator sub-station, which lies right in the city. An accumulator battery will soon be placed in this latter station consisting of 272 cells of Tudor accumulators, giving 468 amperes of maximum discharge and 1,404 ampere-hours capacity; besides this will be installed distributing and regulating apparatus by which the current will be sent through the main lines to the main distributing points. All main lines as well as distributing lines in the main streets will be laid underground, while the rest of the distributing lines will be bare copper wire carried on iron poles furnished by Siemens Bros. & Co., London. The aggregate length of the underground wires is 22.09 miles; of those above ground, 55.9 miles.

The plant must serve to supply 6,000 lamps, of which 400 incandescents of 25 and 35-c. p. and 30 8-ampere arcs are for street lighting.

THE ELECTRICAL WORLD DIGEST

OF

CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Radiation of Refractory Bodies Heated in the Electric Furnace.—In an Academy paper abstracted in "L'Elec.," July 22, Mr. Violle describes experiments made by him in which he found that carbon, chalk, magnesia, zircon and oxide of chromium, although totally different substances, have, in the electric furnace, the same brilliancy and give the same impression to the eye or to the photographic plate. In placing a small piece of carbon in the path of the arc he finds that it is rapidly consumed and becomes hollow on the side toward the cathode, while on the side toward the anode it is covered with pulverized deposit; it appears, therefore, to act exactly like a metal wire in an electrolytic bath, according to the law of Grotthus.

Transparency of Ebonite.—According to the Lond. "Elec. Rev.," July 21, Mr. Arno concludes from experiments that ebonite in thin layers is not transparent in the same degree for all the radiations of obscure heat; it is more transparent for such radiations the more they are refrangible, and in the highest degree for those of the shortest wave length; in thin leaves it arrests the radiations of obscure heat the less they are refrangible; its diathermanous power increases with the degree of brightness of its surface and diminishes with its thickness.

Coil and Condenser in Series.—Prof. Perry, in the Lond. "Elec.," July 21, gives some interesting curves and simple formulæ for the current in a circuit containing a self-induction in series with a condenser; the curves are similar to those of Drs. Bedell and Crehore.

Capacity of Polarization.—"L'Elec.," June 24, reprints a paper by Mr. Bouty in which he confirms the work of Mr. Blondlot; his researches were confined principally to solid and to fused electrolytes.

New Theory of Electrostatics.—"L'Elec.," June 24, reprints an Academy paper of Mr. Vaschy on this subject.

Dimensions of the Absolute Temperature.—In "L'Ind. Elec.," July 25, Mr. Abraham replies to the comments of Mr. Guillaume in the article abstracted in the Digest April 22.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Congress Proposals.—In some brief editorial notes in "Ind. & Iron," July 21, the term "voltage" is termed "barbarous," and the term "pressure" suggested in its place; the term "electromotive force" is claimed to be wrong, as it ought to be applied only to the rate of fall of potential and not to the difference of potential of two points; "this horrible confusion is universal now," electromotive force being "always used to denote what is neither a force nor a force per unit charge, but a potential;" this confusion, it is claimed, has been fatal to clearness of idea as to magnetomotive force, which has been confused with magnetic force; "current strength" is also claimed to be a barbarism, while the term "passing current" is claimed to be a loose expression, as it should be "passing electricity."

Mr. Guillaume, in "L'Ind. Elec.," July 25, reviews the discussion of the American proposals by the German Society, and comments on them, giving, however, nothing new, but calling attention to the proposition made in the B A. report of 1892 for an absolute standard of light.

The "Elek. Zeit.," July 28, reprints in abstract the discussion of the American Institute's proposals at the French Society, adding a few unimportant comments on the same.

One-Volt Standard Cell.—The Lond. "Elec. Rev.," July 28, in describing Prof. Carhart's new cell, states that it was first described by v. Helmholtz in 1882.

Measuring Alternating Fields.—Mr. Hibbert, in referring in the Lond. "Elec.," July 28, to the apparatus described in these columns in the last issue, states that some 15 months ago he used a similar instrument to obtain the shape of alternating magnetic fields; it consisted of an air thermometer with a flat bulb in which is fixed a thin copper disc; currents will be induced in it in all positions except that in which the disc is parallel with the lines of force; it may be used with maximum or with minimum readings. (The same object seems to have been accomplished in a much simpler way by an apparatus shown to the compiler almost 10 years ago by Mr. Mailloux; it consisted simply of a small flat coil connected in series with a telephone, and was used to explore the fields in and around a dynamo; the intermittency of the usual dynamo currents produced sufficient pulsations; it could not be used for uni-polar dynamos nor for fields excited with a battery current: it was really a magnetoscope and only roughly a magnetometer. To compare two alternating fields, as was required in Dr. d'Arsonval's experiments, two absolutely identical coils connected in series, and in circuit with a telephone, would doubtless give much more accurate results, the two coils being placed in the two fields, but reversed so that the telephone indicates any differences.)

DYNAMOS AND MOTORS.

Alternating Current Motors.—Mr. Guilbert, in "La Lum. Elec.," July 29, describes, with the aid of three illustrations, a device of Messrs. Déri and Blathy for enabling a motor constructed like a continuous current dynamo to be used for alternating currents; it consists essentially of inserting coils having resistance and self-induction between the junctions of the coils and the commutator bars, instead of connecting the former to the latter directly; these coils can either be wound on the armature itself or on a separate laminated iron core; in the former case they should be so placed that there is no induction in them due to the field, to the rotation of the armature, or to the periodic variation of the current; all these coils should be wound as nearly parallel as possible and next to one another, the neighboring coils being wound in opposite directions; when one coil of the armature is short circuited by the brushes, the effects of the induction in the two auxiliary coils are added to one another, whilst when the current to the brushes passes through these coils in opposite directions no counter induction is offered by the two coils.

Constant Potential with Variable Speed.—Mr. Schulz, in the "Elek. Zeit.," July 7, gives briefly the results of some tests made with a method proposed by Mr. Hoho (see Digest, May 27, under "Composite Excitation of Dynamos"); the object of this method is to provide a means for maintaining the voltage constant when the speed of the engine, or, more particularly, the turbine, varies; it consists in placing in the circuit of the shunt winding of a simple shunt machine a small auxiliary machine, which is itself a shunt machine, and which is driven from the same shaft, so as to be under the influence of the same variations in the speed; in this arrangement such a proportion can be arrived at that the large machine generates a constant potential independently of the variations in the speed; the E. M F. of the small machine must be opposed to that in the shunt winding obtained from the large machine. Experiments, however, show that the remanent magnetism of the small machine played such an important part that the results were unsatisfactory, even when the pole pieces were bored out very much larger in order to reduce the effect of the remanent magnetism; it could be adjusted so as to regulate for a decrease in speed, but it was found that on a subsequent increase the influence of the remanent magnetism was too great. Another arrangement was tried in which the main machine had two windings, one, a pure shunt winding, and the other a shunt winding with this small machine in its circuit as before; the results, however, were also unsatisfactory, on account of the remanent magnetism. Another arrangement was tried, in which the large machine had two independent windings totally disconnected from each other, one a pure shunt, and the other in series with two small auxiliary machines whose E. M. Fs. opposed each other, the current, therefore, being due to the difference of their E. M. Fs.; the larger of the two small machines was wound as a compound machine; very good results were obtained with this arrangement, the voltage of the large machine being constant up to 1 per cent. with a variation in speed of 16 per cent.

Economy of Ventilating Fans.—The Lond. "Elec.," July 28, reprints an abstract of a paper by Mr. Watel, read before the Society of Chemical Industry, in which he arrives at the conclusion that slow speeds are preferable to high speeds, notwithstanding that for the former a more expensive fan will be necessary for displacing the same amount of air in the same time. Figures are given for actual cases showing that while the slow speed fan may cost more at the start, there is a considerable saving in the power required, which saving in some cases very soon amounts to considerable more than the difference in price of the fans; he states that if 15,000 cubic feet of air are displaced per minute by 1 h. p. the fan is doing excellent work, and any claims of greater efficiency than this can probably not be substantiated by facts; it always costs more to move the same amount of air at a high velocity than at a low one, and it therefore seems to be false economy to employ a small high speed fan, due to the fact that air at double the pressure takes twice and even more power to move it; the best peripheral velocity is not given in the paper, but it is evident that the best diameter of a fan for a given duty will be comparatively large.

ELECTRIC RAILWAYS.

Electric Locomotive.—Referring to the large electric locomotive recently completed by the General Electric Co., the Lond. "Elec.," July 28, criticises its capabilities unfavorably; comparing it with a steam locomotive for shunting (drilling and side tracking trains), it claims that the electric locomotive is quite inferior; it doubts whether a draw bar pull of 12,000 pounds can be had without violent skidding, as such a pull requires the rails to be on a dead level and well sanded, unless the weight of the locomotive be increased considerably over 30 tons, on a gradient of 2 per cent; it claims that there is a doubt whether the engine could start on more than 8,000 pounds; if the normal starting effort be taken as 10,000 pounds, it claims that there cannot be more than one-tenth of this at full speed, even with a series-parallel device for starting the armatures. This would haul a load of about 80 tons on a dead level track in good condition and with a fair wind; under other conditions its capacity would be considerably lowered. "It would seem nearer the actual mark to rate the locomotive as having about 30 tons capacity of haulage over gradients not exceeding 1 per cent."

City & South London Railway.—The English journals of July 28 publish the report of this company for the last six months. The receipts had increased 8 per cent.. the number of passengers carried 12 per cent. and the train

mileage 15 per cent., as compared with the same period last year; yet the total working expenses were slightly less; the locomotive and generating expenses, which were 18 cents per train mile when the roads were first started, and 15.4 cents last year, were below 13 cents during the last six months.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Clocks Operated from Electric Lighting Stations.—The "Elek. Zeit.," June 23, reprints in full a paper by Mr. Hefner-Alteneck, in which he describes in detail and with the aid of two good cuts the system introduced in Berlin. In this system clocks are wound up continuously and set once a day by means of the lighting current from central stations; the clocks are operated by a pendulum which is kept in motion by the usual train of gears and spring, the latter being kept wound up by an ingenious make and break mechanism, which operates a pawl and ratchet, keeping the spring wound up continuously; the spring itself is capable of running the clock for twelve hours, but the arrangement is such that as soon as the spring is but slightly uncoiled it is automatically wound up again; a magnet attracts an armature, which in descending winds up the spring; the make and break device is somewhat complicated; it is fully described in the original; to avoid the injurious effects of the spark on breaking, the device short circuits the magnets first and breaks the current afterward, the resulting spark being that of 100 volts in a non-inductive circuit of 1,600 ohms is insignificantly small and uninjurious. The clocks are set at exactly 5 o'clock every morning by a mechanical device somewhat similar to that usually used in such systems; to actuate the mechanism the voltage on the circuits is reduced momentarily at precisely 5 o'clock, this in turn releases an armature which has been attracted by the electromagnet, and which in falling moves the hands to precisely 5 o'clock by means of a pin which moves into the space between two inclined surfaces located on the wheels which operate the hands; normally, the magnet is just powerful enough to retain its armature; in order not to have to keep the potential absolutely constant during the whole day the armature is raised up to the poles only a short time before 5 o'clock, and the magnet itself is not in circuit until that time, thus avoiding any errors due to an inadvertent fall of the voltage, and, at the same time, saving energy which would otherwise be wasted in the magnet during the 24 hours; the voltage must be kept absolutely constant only for a short time preceding 5 o'clock; the apparatus can be set to be operated by a difference of 1 volt in 100, but it is preferable to use 10 volts. The description of the device for producing this change in voltage is not given. The clocks afford a source of revenue to central stations without increasing the outlay materially; the cost of the current amounts to only 10 cents per clock per year; the system has the advantage over the usual clock systems in not requiring special lines, batteries, attendants, etc.

Alternators in Parallel.—Mr. Mordey, in a recent paper (see Digest April 1, also March 18, 25, and April 8), stated that in connecting and disconnecting alternators in parallel it is merely necessary to regulate the supply of steam to the independent steam engine, and not to vary the excitation; this point was disputed by Mr. Swinburne; in a note in the Lond. "Elec.," July 28, taken from the "Journal of the Institution of E. E.," Mr. Mordey again alludes to this, and gives the replies to questions put to several engineers engaged in the actual running of alternators, in all of which the reply was favorable to Mr. Mordey; this applies, however, to his own alternator, and may or may not apply to others also.

Parsons Steam Turbine.—The Lond. "Elec. Rev.," July 28, publishes an illustration showing an outside view of the steam turbine dynamo and alternator mentioned in the Digest last week; an interesting and curious feature is that the complete combination stands on three legs or supports, which are not even bolted to the floor and apparently require no foundation other than what is necessary to support the weight.

Three-Phase Installation at Lauffen-Heilbronn.—In this pioneer three-phase installation, which has frequently been referred to in these columns, it appears that at first difficulties arose in the switching in and out of the larger motors, owing to the effect on the light. From the "Elek. Zeit.," July 14, it seems that this objection has now been completely overcome, and that the installation is now working with perfect satisfaction. At the end of May, of this year, an aggregate of 41 h. p. was installed in the form of motors, while 20 h. p. additional are at present being installed. In the short period of one and a half years since the installation has been in operation the introduction of motors is said to have been proportionally greater than in any other central station, which proves that a cheap and convenient source of power can be furnished by the three-phase currents.

Mr. Jacquin in "Electricité," June 22 and July 13, gives an illustrated description of this station.

Municipal Stations.—The Lond. "Elec. Eng.," July 21, reprints a paper by Mr. Hammond in which he gives, in the form of a history and statistics, a compilation comparing the municipal stations in England with those owned by companies; his tables show that while the older stations are mostly owned by companies, those in course of construction or projected are mostly to be owned by the cities; the article, it appears, is in favor of municipal ownership.

Fuerstenfeld-Bruck Station.—Lond. "Elec. Rev.," July 21, contains in abstract a translation of the description of this station mentioned in the Digest June 3; the abstract contains no cuts.

Station at Szatmar, Hungary.—The Lond. "Elec. Rev.," July 28, gives a short description of this plant, in which continuous current and accumulators are used.

Dessau Gas Station.—According to the Lond. "Elec. Rev.," July 21, the production of one ampère hour at 110 volts during the year 1892 consumed on an average 159.7 litres of gas, 2.9 litres of water, 1.2 grammes of oil and 1 gramme of cotton waste; with a 120-h. p. engine the best result during five hours for one cubic metre of gas was 994 watt-hours, measured at the terminals of the dynamo.

Portable Plants.—"La Lum. Elec.," July 29, describes at some length and with the aid of nine good illustrations a portable lighting plant constructed by Mr. Fein, consisting of a boiler, engine and dynamo, mounted on wheels like a cart, and a wagon containing all the necessary supplies, including wire, poles, etc.

Lighting Omnibuses.—Mr. Freund replies to the Lond. "Elec. Eng.," in the issue of July 28, regarding a criticism of his paper (see Digest, July 29), but gives nothing new; his letter is commented on at length in an editorial, in which the cost of the lighting is discussed and analyzed.

WIRES, WIRING AND CONDUITS.

Overhead Lines; Iron vs. Copper.—Mr. Snell, in his serial in the Lond. "Elec.," July 28, in discussing this subject gives a table containing the specific resistance, the specific gravity, the breaking strain and the prices of the various wires used. In comparing iron with copper, he shows that as far as the price of the metal itself is concerned a copper line will cost about 27 per cent. more than an iron wire line of the same resistance, but when the total line cost is considered the reverse is the case; the spans may be made about 50 per cent. longer for iron than for copper wire, but as the former is 6.18 times as heavy as the latter, the supporting devices must be correspondingly stronger. The figure of merit of a metal considered by itself may be expressed as the product of the breaking strain and the reciprocals of the specific resistance, the specific weight and the price, the largest figure of merit indicating the best metal; for copper this gives 450 and for iron 1,040, from which it seems that galvanized iron is about twice as good; the expensive posts, the shorter life and the fact that old iron wire has no marketable value, while copper always has (he does not add the increased cost of handling it) are all against iron; for telegraph and telephone lines there is little to choose between the two, but for conveying large currents copper will always work out the cheaper; this applies to bare wires; if insulated, copper is by far the cheaper, assuming that the thickness of the insulation increases as the diameter; bronze wires, which are in general used for telegraph and telephone lines, will inevitably come into favor for transmitting power; the spans can be made 50 per cent. longer than with iron, while less costly insulators are required; he considers silicon bronze the best all round metal for power lines.

Underground Lines.—Mr. Snell in his serial in the Lond. "Elec.," July 28, discusses underground circuits, and describes briefly the Callender solid bitumen and the Callender-Webber drawing in systems: in the former the insulated wires are laid in troughs filled with bitumen, while in the latter they are drawn through conduits made of bitumen concrete (into which, however, the cables are apt to sink, and can therefore not be withdrawn); in the Raworth system, also described briefly, the wires are drawn through pipes laid in troughs filled with bitumen; all three methods are illustrated.

ELECTRO-CHEMISTRY.

Gold Ores.—The new Hannay process of extracting gold from refractory ores, such as contain sulphur, arsenic and other substances which cause the mercury to sicken and flour, mentioned in the Digest July 29, is described more at length in "Ind. and Iron," July 21. The process is based on mercurial amalgamation, an electric current and the use of a dilute solution of potassium cyanide; the solution containing the crushed ore is kept in motion by a propeller, so as to impinge gently on the surface of the mercury, which, being the negative pole, is always bright and cannot sicken, while the electro-deposited brown powdery gold is also absorbed by the mercury; the positive pole is composed of powdered plumbago and powdered pitch and re in solidified by heat, and forms a lining in the lower portion of the vat; the refractory particles of gold are dissolved by the cyanide and transferred to the mercury by the electrolytic action of the current; the time of a charge varies from two to six hours, according to the character of the ore; over 90 per cent. of the gold is said to have been extracted; no previous treatment except crushing is required, and the chemicals are used over again. The Lond. "Elec.," July 21, gives a cut showing the arrangement of the apparatus.

The Lond. "Elec. Rev.," July 21, in criticising this process (a full account of which will be found in the "Mining Journal," July 1), unfavorably, states that Rae, in America, in 1867, was the first to treat ores by the action of electricity and cyanide; references are also given to other earlier American patents. It is furthermore stated by that journal that carbon anodes are even more easily destroyed by cyanide than by chlorides, and that the carbon will probably wear out by the constant rubbing of the ores; a two per cent. solution of cyanide is claimed to be a great deal too much; it is stated that a similar process was tried three or four years ago, and it was found necessary to abandon the mercury cathode, as the weight of the ore broke up the mercury, the loss of which was very great; it is also claimed that the cyanide cannot be used over and over again as the sulphides form sulphuric acid and decompose the cyanide, involving a loss, for which reason Simpson, in America, used carbonate of ammonia in his tank, to prevent the formation of hydrocyanic acid; in conclusion it is claimed that many of Mr. Hannay's statements are the height of exaggeration.

Conductivity of Metallic Fluorides.—According to the Lond. "Elec. Rev.," July 21, Mr. Speransky has found that the conductivity of ferric fluoride solutions is so exceedingly small that it is fair to infer that there can be no appreciable dissociation; with chromic and aluminium fluorides, if any electrolytic dissociation exists it must be excessively small.

Testing for Arsenic.—In testing for arsenical poisoning zinc is commonly used, which, however, generally contains arsenic as an impurity, thus giving false results, on which a supposed criminal's life may depend. According to "Ind. and Iron," a small battery with platinum electrodes will produce the arsenureted hydrogen, if there is any arsenic present, without risk of misleading results due to impurities; notwithstanding this, however, the dangerous zinc method appears to be used still.

Researches with Leclanché and Other Similar Cells.—Mr. Renault in "Electricité," June 15, 22 and 29, describes in detail the researches of Mr. Ditte mentioned before in these columns.

Invention of the Primary Battery.—Mr. Pellissier in "Electricité," July 13, gives a history of the invention of the primary battery.

Barium Accumulator.—In the Lehmann accumulator the active material is composed of peroxide of barium, and the electrolyte is a solution of barium in water.

Physiological Effects of Alternating Currents.—"L'Elec.," June 24, reprints a note by Dr. Leduc, in which he states that alternating currents from electrostatic machines have physiological properties quite different from those usually attributed to alternating currents of high tension and high frequency; they enable one to localize nervous excitation much better than one has been able to do heretofore.

Physiological Effects of Unipolar Faradization.—"L'Elec.," July 22, contains an abstract of a paper by Mr. Charpentier, in which he describes some experiments made with a unipolar application of a current from an induction coil.

Electro-Physiology.—"La Lum. Elec.," July 29, reprints a paper describing some recent experiments of Dr. Leduc with alternating electrostatic currents; an abstract will be found in the Lond. "Elec Eng.," July 28.

Relative Safety and Danger of Electric Light Currents.—A somewhat lengthy discussion on this subject in the form of correspondence has been going on in the Lond. "Elec. Rev." for some time; it contains little of interest, being to a great extent an advertisement of the apparatus of several firms, differing in this respect from the discussion on the same subject in the columns of The Electrical World.

Central Laboratory at Paris.—The Lond. "Elec. Rev.," July 28, publishes an abstract of Mr. De Nerville's description of this laboratory, which has been recently established in its new quarters.

Moonlight Table for September, 1893.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of September under his modified form of moonlight schedule:

TABLE NO. 1. Standard Moonlight. Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	7:00 P. M.	1	10:10 P. M.	1	7:00 P. M.	1	12:00 M
2	7:00	2	11:00	2	7:00	2	12:00
3	7:00	3	11:40	3	7:00	3	12:00
4	7:00	5	12:40 A. M.	4	7:00	5	12:40 A.M.
5	7:00	6	1:50	5	7:00	6	1:50
6	6:50	7	3:10	6	6:50	7	3:10
7	6:50	8	4:30	7	6:50	8	4:30
8	6:50	9	4:30	8	6:50	9	4:30
9	6:50	10	4:30	9	6:50	10	4:30
10	6:50	11	4:40	10	6:50	11	4:40
11	6:50	12	4:40	11	6:50	12	4:40
12	6:40	13	4:40	12	6:40	13	4:40
13	6:40	14	4:40	13	6:40	14	4:40
14	6:40	15	4:40	14	6:40	15	4:40
15	7:40	16	4:40	15	6:40	16	4:40
16	8:20	17	4:40	16	6:40	17	4:40
17	9:00	18	4:40	17	6:40	18	4:40
18	9:50	19	4:40	18	6:30	19	4:40
19	10:50	20	4:50	19	6:30	20	4:50
20	11:50	21	4:50	20	6:30	21	4:50
21				21	6:30	21	12:00 M.
22	1:00 A. M.	22	4:50	22	6:30	22	12:00
23	2:10	23	4:50	23	6:30	23	12:00
24	3:10	24	4:50	24	6:20	24	12:00
25	No light	25	No light	25	6:20	25	12:00
26	No light	26	No light	26	6:20	26	12:00
27	No light	27	No light	27	6:20	27	12:00
28	6:20 P. M.	28	7:50 P. M.	28	6:20	28	12:00
29	6:20	29	8:20	29	6:20	29	12:00
30	6:20	30	8:50	30	6:20	30	12:00

Storage Battery and Underground Conduit Electric Railways.

In his annual report, Chief Walker, of Philadelphia, describes some visits made to inspect various electric railway systems, from which we extract the following:

The storage battery cars of the Eckington and Soldiers Home Railway, Washington, D. C., are run by the Electric Accumulator Company, of Philadelphia, six of them being in service. The railway company operates the road, but the Accumulator company keeps the batteries in repair, recharges them and looks after the electrical maintenance. The batteries weigh nearly three tons per car. The cars are supplied with two 15-h. p. motors; each car runs about seven trips (about 25 miles) before recharging, which is about the limit per charge. The price for running these cars by storage was said by one party to be from three to four cents per car mile in excess of the overhead trolley. From another party it was learned that the Accumulator company was under contract with the railway company to run the cars for three years, and to the best of his knowledge the price was satisfactory and that the company was making money. No figures could be obtained. The statement was made that but once since August, 1891, when they started running, and April, 1892, had the positive plates been renewed, and that the renewal was inexpensive; the negative plates at that time showed no deterioration; about two minutes was taken in removing one set of batteries and replacing them with others. A trip was made in a car that had run its full quota of seven trips, or 25 miles, and ran at a speed of about 13 miles an hour, until a grade of about three per cent. was reached, when it must have fallen to about six miles an hour. The explanation was given that more than half the energy of the batteries was exhausted, and that the plates used in the batteries were of an old pattern, and not of the best. It was stated by one of the railway people that the weight of the cars was destroying the track, but it was not noticeable that either the section over which the storage battery was run or that over which the trolley was run was in any way damaged; both sections appeared to be in equally good condition. It was also learned that the Metropolitan Company of Washington had expended upwards of $250,000 in equipping its entire plant for storage batteries.

In Chicago a thorough examination was made of the underground electric railway. The piece now laid down was laid as an experiment, and is now about 200 feet over a mile and a half in length, and is laid out in the form of a loop. It has four curves, one with a radius of only 35 feet, crosses at one curve two lines of track, one a cable road, and uses one street, which is the most heavily traveled street for teams in that city; it has been in operation since March 1, 1892, and has purposely been subjected to every obstacle possible. The construction was carried on through the most inclement weather, and the cars have been, so we were informed, run every day since March 1, regardless of weather, though not continuously. The motor car weighs nine tons; from the bottom of the car a plate five inches wide runs down through the slot to which the trolley wheels are attached. This motor car hauled five loaded trailers, and is geared to develop 30 h. p. The construction, looking at it in the street, is just the same as in the cable slot. The conduit is of cast iron, 12 by 15 inches, supported by yokes of cast iron four feet apart, which extend across and carry the rails; the slot in the casting proper is about two inches wide; over the top, however, from both sides fits the slot bar of steel, the lower edges extending below the trolley wires, protecting them from moisture and interference and reducing the opening to about five-eighths of an inch. The trolley wires are suspended under the slot bar or the frame it covers, one on each side, being secured at each yoke at intervals of four feet, the insulation being molded mica, which is so fastened as to yield to the expansion and contraction of the conducting wire (No. 0000) and at all times hold the wires rigid and in one line; there being two trolley wires the circuit is metallic and there is no connection with the rails.

The conduit is drained about every 100 feet into the sewer, and at intervals of 100 feet manholes four feet in depth below the conduit are built; the slot bar is in lengths of 36 feet, and can be removed at any time, being bolted to the yoke, so as to furnish easy access to the conduit; traps are also placed at frequent intervals to give access to the manholes for the removal of obstructions.

To the flat metal grip running from the car down into the conduit are attached two brass trolley wheels, held up in close contact with the trolley wires by two springs. The wheels are set on an axle like a swivel, so as to hold them against the wire in rounding a curve, or in case of the car jumping. So far the system has worked in spite of obstacles, which were many; spikes have been driven into the slot; the result was the spike was knocked out, or the trolley wheels or plate gave way. If the latter happened another trolley had to be put in, which caused the delay of but a few minutes. In one case a bar of iron was wedged across the conduit; it tore away the strip carrying the trolley wires, but it was speedily removed, repairs made, and the car went along as usual. The voltage used is about 500; the escape of current is not sufficient to materially interfere with the operations of the road, and this has been the case in all kinds of weather. The car ran continuously about ten days previous to the visit in one of the heaviest rainfalls seen in Chicago for years. This rain deluged the streets, the water being in places up to the top of the curbs; all the water that found its way into the conduits though the ⅝-inch slot was carried off to the sewer, or went to the deep manholes—these latter are for drainage in such emergencies, and also to catch the dirt; occasionally a brush is attached to the car, and run through the conduit, sweeping all out to the manholes. This brush fits the conduit closely, and scours it completely; the dirt swept to the manholes is taken out and carted away.

Electricity in Mining.

In a paper read by Mr. F. O. Blackwell before the Mining Engineering Section of the International Engineering Congress, at Chicago, it is stated that there are some 300 companies in the United States engaged in mining and the kindred arts that now employ electricity in their operations. Nearly all of the plants are supplied with current at 220 or 500 volts, but there are a number in which voltages of 1,000 and over are employed.

In regard to economy, an example is furnished by the Virginius mine, at Ouray, Colo.; 300 h. p. is carried at 800 volts from a water power four miles distant. The cost of coal at the mine was formerly $18 per ton, which would amount, for the present plant, to about $80,000 per year, equaling the total cost of the electric plant. The item of fuel was a complete saving, the expense of operating the steam and electric plant being about the same in other respects. Several mines in Colorado are operated by electricity that could not be by steam on account of their situation on the face of precipitous cliffs, up which the transportation of water and fuel would be nearly impossible. The character of the country over which the power had to be carried for the Virginius plant is exceedingly rough. A portion is at an elevation of 12,700 feet above sea level and well above the snow line.

The great facility of the application of electric hoists is referred to, and an instance given of mine hoists that have been in operation for two years with a total cost for repairs of $23.

When applied to electric pumping the best method for controlling the speed is stated to follow from making the fields of such strength as to give the minimum speed desired, so that by decreasing the current in them the speed may be increased to the maximum output. Where many pumps are in operation of nearly the same size, a convenient method of regulation is to throw the pumps in multiple series combinations with each other.

Electrical Papers at the World's Fair Engineering Congress.

The following papers having more or less relation to electricity were presented at the World's Fair Engineering Congress, which held its sessions from July 31 to Aug. 4, at Chicago:

Electrical Engineering, by Prof. H. S. Carhart (Div. Eng. Education).

Range and Position Finding for Purposes of Gunnery, by W. O. Smith (Elliot Bros., London), (Div. Military Eng.).

Speed and Revolution Recorder, by W. D. Weaver (Div. Marine and Nav. Eng.).

Terrestrial Magnetism of North America, by C. A. Schott (Div. Civil Eng.).

Anemometry, by S. P. Ferguson (Aerial Navigation Conference).

The Electric Light Plant of Guadalajara, Mexico, by R. M. de Arozarena (Div. Civil Eng.).

The Relative Merits of Working Hoisting Machinery, by Steam, Water and Electricity, by George A. Goodwin (Div. Civil Eng.).

Performance of Street Railway Plants, by W. A. Pike, (Div. Mech. Eng.).

Electric Welding, by E. C. Moxham (Div. Metallurgical Eng.).

Improvements in the Art of Cable Making, by Emil Guillaume (Div. Mech. Eng.).

Improvement of the Ship's Log, by William Cowles (Div. of Marine and Nav. Eng.).

Carbon and Its Uses in Electrical Engineering (Div. Civil Eng.).

The Electrical World's Visitors.

The following have registered at The Electrical World's headquarters since our last bulletin:

A. L. McMuntry, Belmont, Mass.; G. S. Flegel, Vinton, Ia.; R. S. Crawford, Phenicia, N. Y.; E. P. Sullivan, New York, N. Y.; Wm. Hubbard, Elgin, Ill.; Robt. Waide, M. D., Indianapolis, Ind.; Benj. H. Glover, Chicago, Ill.; H. S. Humphrey, Indianapolis, Ind.; G. M. Sanborn, Indianapolis, Ind.; S. B. Loche, Philadelphia, Pa.; Helen F. T. Cleaves, W. Gouldsboro, Me.; R. Friplett, Pittsburgh, Pa.; J. E. Olson, Chicago, Ill.; H. B. Pickwell, Auburn Park, Ill.; R. G. Stewart, Memphis, Tenn.; R. C. Millen, M. D., Shannon, Ill.; Wm. W. Christie, Milwaukee, Wis.; Wm. Elmer, Jr., Princeton, N. J.; A. L. Reinhold, Ardmore, Pa.; Geo. Morgan Lewis, New York; Chas. W. Demarest, New York; A. Goddard, Brockwayville, Pa.; W. H. Reynolds, Lawrence, Kan.; H. S. Alster, Christiana, Norway; C. R. Truex, 18 Cortlandt St., New York; Jno. H. Stevenson, Jr., New York; A. Barnes, Fort Wayne Electric Company; A. L. Hadley, Fort Wayne Electric Company; James J. Wood, Fort Wayne Electric Company; Henry S. Carhart, Ann Arbor, Mich.; Walter M. Petty, Rutherford, N. J.; Philip W. Davis, Cambridge, Mass.; W. M. Gregory, Jonesville, Mich.; W. T. White, Knoxville, Tenn.; J. N. James, Washington, D. C.; Chas. Root, Beatrice, Neb.; J. M. Quinlan, Chicago, Ill.; P. A. Sperry, Washington, D. C.; Wellington Adams, St. Louis; Francis E. Nipher, St. Louis; I. Kyum, Denmark; J. C. Watt, Saranac, Mich.; Howard Frace, Saranac, Mich.; C. A. Frace, Saranac, Mich.; Dr. I. J. Reis, Saranac, Mich.; F. A. Van Vranken, Tabor, Ia.; Claude Hume, Tabor, Ia.; I. Baily, Madisonville, Ky.; H. E. Wordworth, New Castle, Pa.; H. L. Balack, Duquesne, Pa.; James H. Mason, New York City; J. A. Williams, Cleveland, O.; E. P. Procter, Charles City, Ia.; J. N. James, Naval Observatory, Washington, D. C.; A. E. Dolbear, Tufts College, Mass.; Harry M. Lord, Baltimore, Md.; T. Walter Hedian, Baltimore, Md.; F. Stewart Gassaway, Baltimore, Md.; C. F. Rossman, Baltimore, Md.; E. J. Hart, Grand Rapids, Mich.; W. N. Matthews, St. Louis; John Hubbell, Bridgeport, Conn.; W. C. Bryant, Bridgeport, Conn.; E. A. Strong, Ypsilanti, Mich.; W. L. Newton, Shelburne Falls, Mass.; H. E. King, Quincy, Ill.; Harry D. Lasker, Minneapolis, Ill.; Geo. Huntizcker, Neillsville, Wis.; Henry A. Truitt, Oak Lane Electric Light Company, Philadelphia, Pa.; Elisha Gray, Highland Park, Ill.; E. Hospitalier, Paris; B. J. Arnold, Chicago, Ill.; Jerome Green, E. E., Columbus, O.; Thos. E. Clark, Detroit, Mich.; J. W. M. Crosby, Pittsburgh, Pa.; Burt A. Miller, Canton, O.; Wm. L. Goette, Milwaukee, Wis.; Chas. H. Kamphoefner, Burlington, Ia.; Miss Laurette Lovell, Tucson, Ariz.; Amos H. Haines, Philadelphia, Pa.; E. Waxweiler, Ghent, Belgium; F. J. Todd, Seattle, Wash.; Fred A. Scheffler, New York City; T. J. Kirkpatrick, Springfield, O.; C. C. Caldwell, E. E., Springfield, O.; G. M. Kaumann, Berlin; R. Woolson, Mt. Pleasant; F. P. George, Chicago, Ill.; E. M. McDuff, Detroit, Mich.; Frank S. McDuff, Detroit, Mich.; Edgar Larkin, Galesburg, Ill.; Rno. Franke, mechanical engineer, Hanover, Germany; J. A. Stephens, Muncie, Ind.; G. W. Foster and wife, Dallas, Tex.; Elmer E. Wood, New York; Harry Wharton, C. & A. W. Ry. of England; J. Roslin, Paris Society of Electricians, France; E. Champion, inventor electrical pyrotechnics, Paris.

Electric Traction on the Pacific Coast.

Mr. Charles Hewitt, inspector in the Railway Department of the General Electric Company, recently made an official report to Mr. O. T. Crosby, General Manager of the Railway Department, upon the condition of the railroads and railway apparatus upon the Pacific coast, which embodies some features of interest.

The Metropolitan Railway of San Francisco has four miles of double track and 15 single-truck cars equipped each with two W. P. 50 motors, the power being furnished by three M. P. 90 generators. In speaking of this road, Mr. Hewitt says:

"The service on this road is very severe indeed. The grades are numerous and very heavy, reaching 13½ per cent. The motors are well cared for, and consequently are giving great satisfaction. An experiment is about to be tried on this road, using the motors as brakes for descending the steep grades. They first tried simply short-circuiting the motors, but with this arrangement the car ran too slow. When I left they were fitting a car up so as to short-circuit through a rheostat."

The San Francisco & San Mateo, which is a somewhat larger road, has been unfortunate in its financial affairs, which may account for the bad management of the apparatus, more particularly the motors. Axle brasses have been taken from these motors that were not only worn through, but the axle had cut nearly half an inch into the iron. The Oakland, Oakland Consolidated, Consolidated Piedmont Cable, East Oakland, Highland Park & Fruitvale, Oakland, San Leandro & Haywards, Oakland, Alameda & Piedmont, Santa Cruz, First Street (San Jose), San Jose & Santa Clara railways are all equipped with General Electric apparatus.

"These roads, and especially those in Oakland," says Mr. Hewitt, "are in exceptionally good condition. On some of those equipped with the W. P. motors burnt-out armatures are entirely unknown, and cripples from any causes are very rare. The little troubles which have caused so much annoyance on our Eastern roads do not seem to have bothered these roads at all. The secret of these good results undoubtedly lies in the fact that no car is allowed to run longer than four weeks without being overhauled. Those roads which have only a few cars overhaul them as often as every two weeks. If the barn is properly equipped, one good man and a helper can overhaul one pair of motors a day. So that two men can take care of 25 cars and have time for repairs to trucks and brakes, and every car receive an overhauling once a month. In addition, the cars get the usual cleaning and inspection at night. It seems odd that more of our Eastern roads do not

adopt this method of operation, as it certainly is the easier and cheaper method. These roads have all experienced the usual troubles with gear cases, loose sleeves and collars on armature shafts, etc., but the regular overhauling has prevented any serious trouble.

"Complaint was made of the Alameda cars that in case of delay they were unable to make up time. To overcome this, our district engineer, Mr. Lighthipe, placed a 3-ohm shunt around the field coils, connecting it through a snap switch. The motormen understand that this is to be used only in case of delay. The use of this shunt, I was told, increased the current through the armature about five amperes and increased the speed about five miles per hour.

"The San Leandro & Haywards road is particularly interesting on account of its apparent good management and the speed which the cars make. The distance from Oakland to Haywards is 15 miles, and the distance has been made, I believe, in 35 minutes. These cars attain a speed of at least 35 miles per hour, and some make a daily average of over 200 miles. One of these cars is equipped with the Genet airbrake. It also has an air whistle. This brake has not been in use very long, but up to the time of my visit it had proved very satisfactory.

"The only other roads in California are at Sacramento, Stockton, San Diego and Los Angeles. I did not visit these roads, but I learned that almost no trouble is experienced. All these roads are equipped with General Electric Company's apparatus, except the Los Angeles roads."

There are three electric roads in Portland, Ore.: The East Side Railway, in which the current is carried a distance of nine miles from the station, the generators running at 600 volts; the City & Suburban Railway and the Portland Consolidated Railway. Considerable trouble was experienced last winter by all the roads in this vicinity on account of the unusual snowfall.

The Tacoma (Wash.), Port Defiance, Tacoma & Edison, Seattle Consolidated, the West Street (Seattle) & North End railways were all inspected by Mr. Hewitt. The Union Trunk line (Seattle) has an 8 per cent. grade for nearly a mile, and part of this is on a long curve. The Ranier Avenue Electric Railway in the same city has a grade of 16.85 per cent., on which a counterweight is very successfully used. The rope with the counterweight travels in a conduit between the rails. The road is a single track and each descending car draws the counterweight to the top, and each ascending car lowers the counterweight. In this way the car is assisting in ascending, and a safety device is provided while descending.

The Grant Street Railway (Seattle) has 10 single W. P. 30 equipments. It has a power house of its own, but finds it cheaper to buy power from the Consolidated Railway. Two men keep these cars in repair. The motors are overhauled regularly about once a week, and consequently they are in good condition. The line work on this road is constructed with hangers of local make.

On the road at Spokane Falls the cars are not overhauled regularly, and a great deal of repairing has been done, but this is probably due to the old type of motors.

Mr. Hewitt remarks that all these roads, except at Portland, have been largely built in anticipation of the population, and it is impossible that they should be paying. This may account for the neglected condition of the motors.

Central Station Triple Expansion Engines.

One of the finest central station plants in the country is that of the Elmira Illuminating Company, which reflects great credit not only on the designer, Mr. F. A. Cheney, the general manager of the company, but on the various firms that have supplied the high class machinery contained in it. Among the striking features of the plant is a triple expansion engine supplied by McIntosh, Seymour & Co., Auburn, N. Y., of which we give a description below.

The engine is of the four-cylinder triple expansion type, with high pressure and intermediate cylinders each tandem with one of the two low-pressure cylinders.

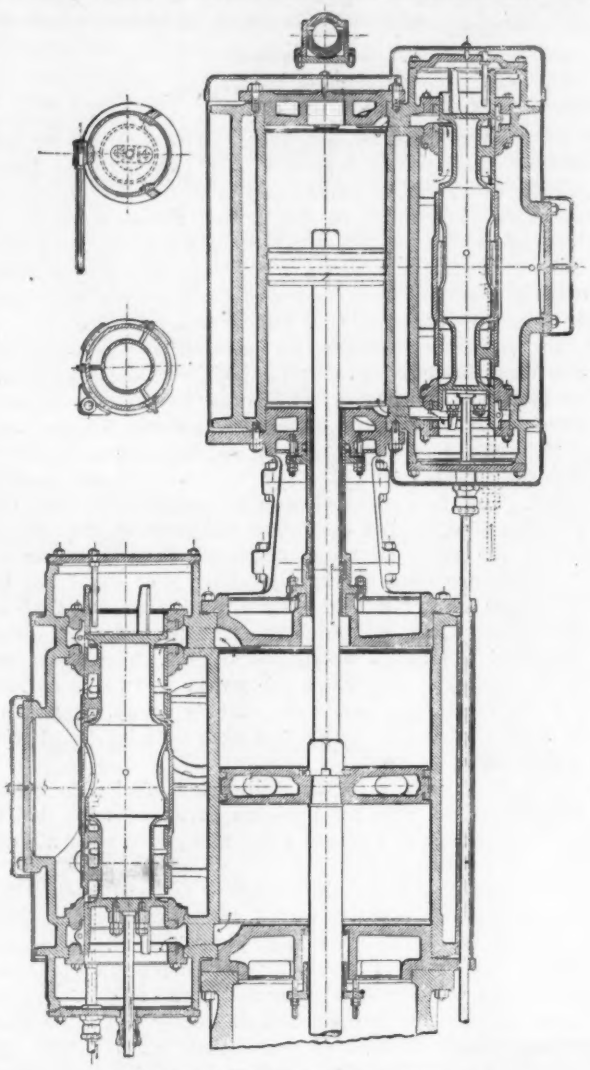
The frame supporting the cylinders consists of heavy cast iron box uprights bolted to the bed plates on one side of the engine, and turned forged steel columns on the other side, with flanges forged on their ends to bolt to the bed plates and cylinder heads.

The rear upright is made very heavy, and stiff enough to serve even though the steel columns were removed. The latter can be taken out and the entire engine is very easy of access.

The connecting supports between the low-pressure cylinders and the high and intermediate are so arranged that the upper low-pressure cylinder heads can be removed without disturbing these supports.

There are no stuffing boxes between the cylinders, a packing sleeve taking their place. This consists of a long tube babbitted and bored out to fit the piston rod. It has a large surface, and acts as a guide to the pistons and rod, greatly adding to the smooth running of the engine, in addition to the advantage of doing away with the stuffing boxes and preventing leakage from one cylinder to another. The cylinders are provided with the regular double valve arrangement of the manufacturers whereby the opening and closing of the exhaust and admission of the steam are regulated by fixed eccentrics, driving the main valves, and the cut-off is controlled by an auxiliary valve driven by the governor, this valve being placed on all cylinders. The accompanying cut shows a practically similar arrangement of the cylinders, except that the connecting head is adapted to a horizontal engine, the cut being a section through the cylinders of the 1,200 h. p. engine in Machinery Hall, at the World's Fair, built by this same firm.

The governor consists of an arrangement whereby the



Section Through Cylinders.

auxiliary or cut-off valve eccentrics are merely turned around on the shaft by the centrifugal weights, their position being controlled by the governor weights. By a series of variable strokes with the auxiliary valves, the load is divided equally between the cylinders, and also the drop in temperature between the initial and exhaust temperature in each cylinder. This makes the engine work, under the best conditions, under all loads without any hand adjustment.

The main bearings are provided with removable cast which are also shown in the cut referred to. The valves, valve gear and eccentrics are so counterbalanced that they are in static equilibrium.

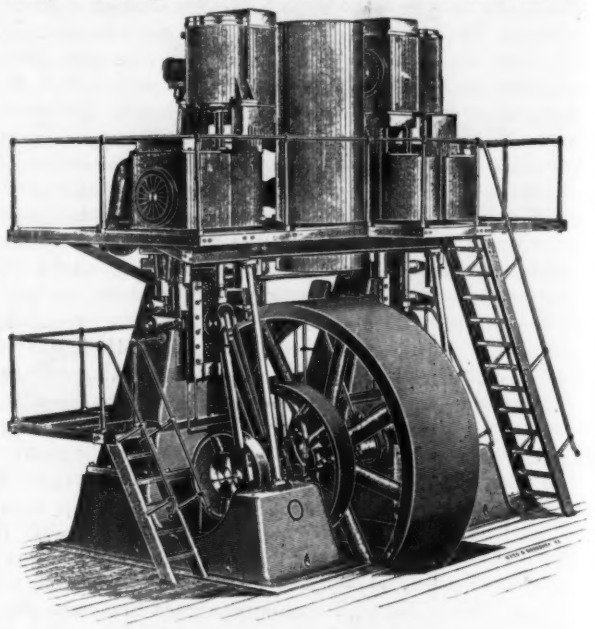
The crosshead is of one piece of phosphor bronze, and is of the slipper type. The guides are bolted to the upright, and are removable and adjustable for wear and are water jacketed. The connecting rod is of a standard gib and key type. The shaft is made of open hearth steel, and also the crank pins, both being forced into the discs, which are made of charcoal iron.

The important parts, such as discs, cylinders, etc., are made from special heats of hard close grained charcoal iron. The shaft is provided with outside cranks at right angles to each other, and a fly wheel between the two halves of the engine; the frames are connected by wrought steel braces, supporting platforms and receiver.

The main valves are provided with adjustable seats, iron shells, lined with anti-friction metal, and water jacketed. They are so arranged that by lifting the shaft and wheel slightly by screws which are provided for this purpose, under the discs, they can be removed without disconnecting any gear of the engine, the entire operation taking only a few minutes. This is a great convenience if it is desired to examine or gain access to the main bearings, and will be appreciated by engineers.

The high-presure cylinder is steam jacketed, and the intermediate and low-pressure cylinders are provided with receivers of large capacity having brass heating coils. The receivers and cylinders are lagged with iron made to represent wood, covering a thick layer of asbestos fibre. Each side of the engine is provided with oil tanks with sight feed outlets, and leading pipes to each bearing and pin requiring constant lubrication, and the beds are provided with pockets for catching all oil. It condenses into a Blake independent condenser, the suction pipe being 4,000 feet long.

The weight of the engine complete is about 115,000 pounds, the driving wheel being 12 feet in diameter by 52-inch face, and weighing 20,000 pounds; the high-pressure cylinder, 14 inches diameter; intermediate, 23 inches; and two low-pressures, 26 inches in diameter each, all having a stroke of 24 inches. It runs at 137 revolutions a minute, and will develop 500 h. p. with 150 pounds condensing. The engine is designed to run ordinarily at 150 revolutions, and develop 600 h. p. The construction is so thorough and massive that there is no perceptible vibration of the upper platforms at speeds of 30 or 40 revolutions above that intended.



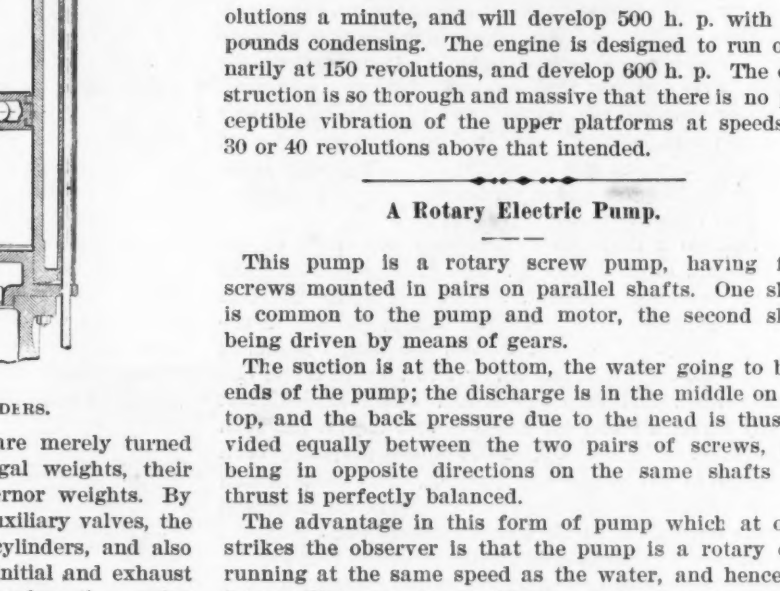
A Triple Expansion Engine.

A Rotary Electric Pump.

This pump is a rotary screw pump, having four screws mounted in pairs on parallel shafts. One shaft is common to the pump and motor, the second shaft being driven by means of gears.

The suction is at the bottom, the water going to both ends of the pump; the discharge is in the middle on the top, and the back pressure due to the head is thus divided equally between the two pairs of screws, and being in opposite directions on the same shafts the thrust is perfectly balanced.

The advantage in this form of pump which at once strikes the observer is that the pump is a rotary one, running at the same speed as the water, and hence all intermediate gearing, with its consequent wear and loss of power, is done away with. The flow from the pump is perfectly regular, doing away with the pulsations due to a reciprocating pump. There are no valves in the pump, so that pieces of grit or thick liquids will pass freely through the pump. Having no internal packing or any small moving parts repairs are in this way reduced to a minimum.



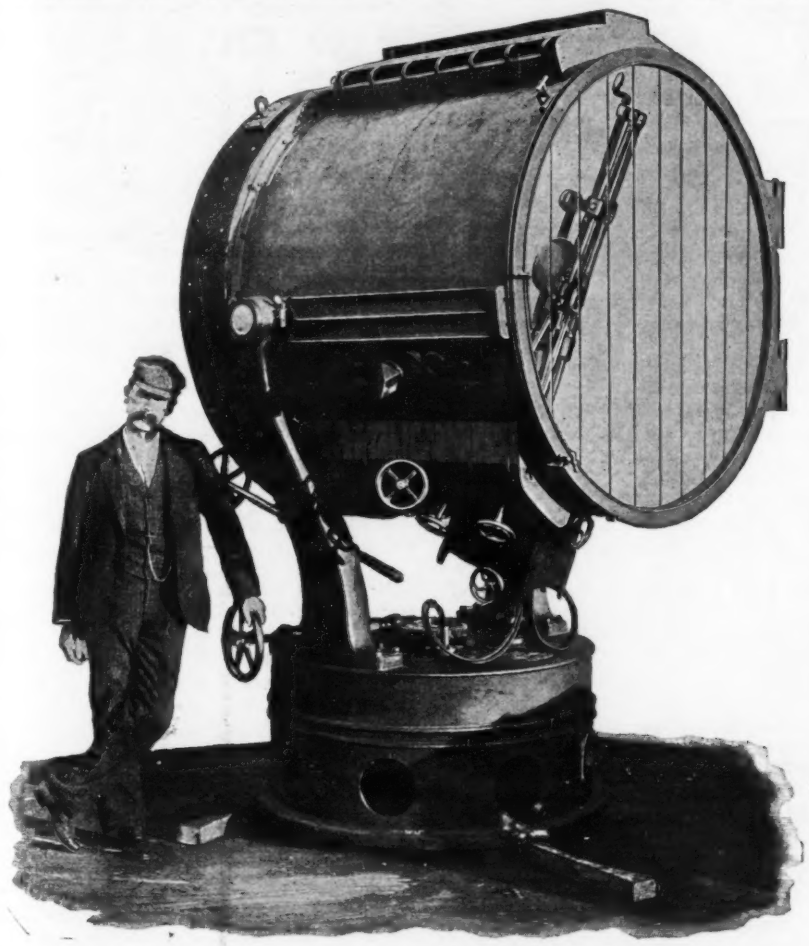
A ROTARY ELECTRIC PUMP.

The pump shown in the cut is directly connected with a Waddell-Entz 5-h. p. motor, running at 900 revolutions, and with a capacity of 50 gallons per minute against a head of 225 feet,

These pumps, which are made by William E. Quimby, 59 Liberty street, New York, are of various sizes, the largest running at 400 revolutions, with a capacity of 625 gallons per minute. As the motion is purely rotary, the pump does not need a special foundation, and this, in connection with its ability to handle gritty substances, particularly adapts it to quarry work.

The Largest Search Light in the World.

To America belongs the honor of constructing the largest and most powerful electric search light in the world, now being set up at the World's Fair. Some idea of its size may be gained by the comparison made between it and the men of ordinary height standing by it, shown in the illustration from a photograph taken when the search light stood on the roof of the factory. It stands about 10 feet 6 inches high to the upper side of the ventilator on the top of the drum, and the total weight is about 6,000 pounds, but so perfectly is it mounted and balanced that a child can move it in any direction. It was built by the General Electric Company. The reflecting lens mirror used in this projector is 150 centimetres, or 60 inches, in diameter. It is a concave spherical mirror of the Mangin type, free from spherical aberration, reflecting a sensibly parallel beam of light. It was manufactured especially for this projector in Paris, France, and is a most perfect specimen of optical work, 3¼ inches thick at the edges and one-



A MONSTER SEARCH LIGHT.

sixteenth of an inch thick at the centre, and weighs about 800 pounds. The metal ring in which it is mounted weighs about 750 pounds, and the total lens, ring and cover weigh about 1,600 pounds. This great mirror is mounted at one end of the big drum, the outer end of which is furnished with a door consisting of a metal rim in which are fixed a number of plate glass strips five-sixteenths of an inch thick by 6 inches wide. Inside this drum and sliding upon ways arranged on the bottom, is placed the electric lamp, the source of the light which is reflected by the mirror. It is entirely automatic in its action, is 6 feet high and weighs about 400 pounds. The carbons used are also made especially for it. The upper or positive carbon is 1½ inches in diameter and 22½ inches long, with a five-sixteenths of an inch core of soft carbon running from end to end through its centre. The lower or negative carbon is 1¼ inches in diameter, is 15 inches long, and also has a core of soft carbon running through its centre. In addition its outer surface is heavily coated with copper. The positive carbon is set a little in front of the negative, and thus almost all the intense light of the incandescent crater is cast upon the reflector. The maximum current at which this lamp operates is 200 amperes, and at this current the lamp has a luminous intensity of about 90,000 to 100,000 candles, the reflected beam a total luminous intensity of about 375,000,000 candles, an intensity which the eye cannot appreciate. In looking at the side of the beam the spectator only distinguishes a stream of light of comparatively low intensity, but in looking at the beam directly its brilliancy is fully seen and the effect is absolutely blinding. Ventilators at the top and sides allow a constant current of air to pass through the drum and dissipate the heat generated by the arc lamp; and they are so arranged that no light can escape through them. All the connections for adjusting the positions of the carbons and the lamp are brought through the drum to the outside, and are arranged in close proximity to one another at one side so that all may be manipulated by the operator without moving from his position. Through openings in the drum covered by densely colored glass the operation of the lamp may be watched, and its adjustments verified. The drum is supported by trunnions in bearings at the top of a Y-shaped fork, set in a base plate, and the whole is supported on a system of friction wheels, forming a turntable resting upon the top of a massive pedestal supporting the whole structure. The drum, fork and base plate may be rotated horizontally on the turntable either by hand or by gearing provided for this purpose. The drum may also be elevated or depressed vertically by similar gearing.

Before the projector was sent to the World's Fair, a public test was made at Middletown, Conn. From the roof of the works the great white beam of light shot forth into the obscurity of the night, and slowly swept the country side for miles around, bringing every object upon which it was directed into brilliant and distinct relief. It illuminated the roofs of distant villages and scared their inhabitants, and lighted up the signboards miles away, so that they could easily be read by means of a glass. The projector was turned upward toward the sky, and the beam, like a supernatural divine finger, wrote words upon the clouds—messages of light to the starry populations.

It was observed that the space within the beam was violently agitated, and closer observation revealed the fact that millions of moths and minute insects were hovering in it, attracted by the brilliancy of the light. Next morning bushels of dead moths, beetles, other insects and some small birds were swept up from the roof on which the projector stood. They had been killed by the intensity of the light.

How far the powerful beam of light of this instrument can be seen is difficult to state. The search light set up by the General Electric Company on Mount Washington in the White Mountains has a diameter of only 30 inches, and a reflected light from the mirror of about 100,000 c. p., yet a newspaper can be read in its beam 10 miles away, and the light can be seen from points 100 miles away. How much farther, then, could this 375,000,000-c. p. light be seen in a clear atmosphere free from moisture, if the projector could be mounted upon an eminence sufficiently high to clear all surrounding obstacles?

NEW BOOKS.

THE LAW OF INCORPORATED COMPANIES OPERATING UNDER MUNICIPAL FRANCHISES. By Allan R. Foote and Charles E. Everett. Cincinnati: Robert Clarke & Co. 3 vols.; 3,000 pages. Price $15.00.

In every line of business the modern tendency is toward incorporation. Judge Brewer, of the United States Supreme Court, recently stated it to be his firm conviction that 50 years hence all business, except such as is done on a very small scale, will be transacted by corporations. In view of this fact, and of the numbers of new franchise companies being organized, this work will be of especial interest and value to the alert business man. The work, as its title indicates, deals only with corporations operating under municipal franchises; but as the fundamental principles of the law in relation to all corporations are nearly uniform, there is much in the work which indirectly concerns private corporations.

The work consists of a discussion, by Mr. Allan R. Foote, of the economic principles governing the operations of franchise corporations, and some very valuable suggestions as to the best manner of enforcing the visitorial powers of the State, or other creative power, and obtaining better service from such corporations. This is followed by an excellent general historical sketch and consideration of the principles upon which the laws governing this class of corporations rest, by Mr. Charles E. Everett. The feature of the work, however, which will be of the widest range of use is a collection, by States, of the laws affecting these industries. Under the head of each State is given, by a resident attorney of that State, a historical sketch of the origin and growth of these corporations and an account of the policy of the State toward them. Under appropriate heads is also given the law upon the subject of incorporation, organization, franchises, etc. Each State section, in short, gives the entire law of the State, constitutional, statutory and judicial, relating to franchise companies and the industries carried on by them. The same plan is also followed in respect to the general United States laws, those of the territories and of the District of Columbia. The scope of usefulness of this compilation of the laws upon the subject cannot be overestimated. Here is presented in a shape exceedingly handy for reference, or for comparison with each other, all the laws of this country upon this subject. The want of just such a reference book has long been felt by every statesman, lawyer and modern business man. The work of editing and revising these State sections has been performed by Mr. Everett. His work is well and carefully done, and he deserves the utmost credit for it.

The discussion of the economic principles involved, by Mr. Foote, shows a close, careful and detailed study into the workings of this kind of corporations. He argues in favor of the establishment of a department of municipal administration clothed with power to compel the corporations to render to it exact accounts of all matters pertaining to their business, and favors giving this department an equity jurisdiction to hear and determine questions affecting the corporations. There is great force in the argument, and, moreover, there is no doubt but that the visitorial power of the State over corporations of all kinds should be more strict and impartial than at present. In this respect Mr. Foote is in line with the latest and ablest authorities upon this matter, but at the same time, to a casual reader, the very forcefulness of the argument might be apt to destroy in part the value of the work as a work of reference, were it not for the impartial manner in which it is written, and the evident care and painstaking shown in the preparation of the entire work. To any observer it will be apparent that the work can be taken as sound authority upon the subject.

The work consists of two large volumes and a bound index. It is gotten up in excellent style, and will throw much light on a subject which, in this country, is as yet but little touched upon. It cannot fail to take high rank with other works bearing upon this branch of the law.

ELECTRICAL DISTRIBUTION. ITS THEORY AND PRACTICE Part I., by Martin Hamilton Kilgour; Part II., by H. Swan and C. H. W. Biggs. London: Biggs & Co. 424 pages; 174 illustrations. Price, $4.

In the first part of this work the principles which govern the distribution of electrical energy are considered, and in the second part are collected descriptions in detail of different systems of distributing cables, conduits, etc.

The design of conductors is treated at length for different classes of distribution, over one hundred pages being devoted to the various problems under this head. Particular attention is paid to economy of design as developed by Lord Kelvin and Messrs. Ayrton and Perry, and to the load diagrams of the systems considered. This treatment is far more exhaustive than in any other work that we know of, and in this respect especially the book will prove very useful to electrical engineers. We note, however, that the calculation of networks is not included. Several tables are given to facilitate calculations.

In the second part detailed descriptions of various underground systems and cables are given. With the exception of the Brooks oil insulation system, all refer to European practice, but this does not signify that much may not be learned, as underground work has been developed there along a number of lines and with good results.

PORTATIVE ELECTRICITY. BEING A TREATISE ON THE APPLICATIONS, METHODS OF CONSTRUCTION AND MANAGEMENT OF PORTABLE SECONDARY BATTERIES By J. T. Niblett. London: Biggs & Co. 234 pages; 90 illustrations. Price, $1.00.

The aim of this book is to serve as a guide to those who may wish to learn in what manner electricity may be adapted to various uses in which the light or the battery is required to be portable, and is written in a popular style, technicalities being avoided as far as possible.

Portable electricity is considered as adapted for mining, surgical and other scientific work, signaling, lighting carriages, cars, etc., and decorative and spectacular purposes. Descriptions of some forms of primary and secondary cells are given, and about fifty pages are devoted to useful directions for charging secondary batteries. The book is well illustrated and will be found interesting to the many who take a general interest in electricity as well as useful to those who wish to apply the information given.

ELECTRIC LIGHT INSTALLATIONS. VOL. I. THE MANAGEMENT OF ACCUMULATORS. A PRACTICAL HANDBOOK. By Sir David Salomons, Bart., M. A. Seventh edition, revised and enlarged. London: Whittaker & Co. New York: D. Van Nostrand Company. 1893. 164 pages; 33 illustrations. Price, $2.00.

The seventh edition of this well known work will be in two volumes, the first of which, just issued, is devoted to the management of accumulators. The excellent character of the information given on this subject received recognition by passing the book through several editions. As the various instructions and hints are based upon actual experience with a large accumulator plant, they can be relied upon; and as no other work enters so largely into necessary detail, this book should be in the hands of all who have to deal with the actual working of storage batteries.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Aug. 12, 1893.

GENERAL ELECTRIC closes this week a little lower than last Saturday. Bear traders, discomfited in their endeavors to keep up the decline, have been seeking all week weak spots, whereby to assail the general list. The lack of support that General Electric received during former assaults led the bear clique to believe that campaigns directed in this quarter would be as successful as those carried on in the two weeks previous to the current week. This time, however, General Electric failed to yield in a manner suggestive of insiders holding the price. The bears spread any number of discrediting stories. Receivership talk, however absurd it was, was again put into use; then they capped the climax by industriously spreading a report that notes of the company falling due this week at Providence would be allowed to go to protest. The prompt denial of these stories and the successes attending the efforts of the underwriting syndicate to liquidate the $4,000,000 floating debt, puts a quietus to all such talk, and the general confidence in General Electric is a good deal more widespread. Wall street heard, too, this week of another story about General Electric, to the effect that owing to the general demoralized condition of business throughout the country the earning power of General Electric has fallen off so materially, that if continued the company is sure to find trouble in financing to provide against impending disaster. A further obligation of considerable proportion is said to be on the tape.

WESTERN UNION has been benefited by the demand which has arisen among small investors and bargain hunters for dividend-paying stocks. To show in what class of hands the stock is falling it is stated that during the five days beginning July 31 Western Union gained 450 stockholders, most of whom held less than 50 shares. It is estimated that less than 10 per cent. of the capital stock of the company is now in the name of brokers or brokers' clerks. With the return of Mr. George Gould better support to the stock has been rendered in the past few days. The officials still refuse to give any figures of test office receipts, claiming that they are for private information. But it is known that earnings continue to decrease. The stock market course of the stock will, however, be benefited by the fact that the liquidation of the large account said to be for the Baltimore & Ohio Railroad, of which mention was made last week, is understood to have been completed.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY continues to try to save money for stockholders by retrenching as far as possible. Only a third of the usual force of men is now at work at the Pittsburgh shops, and only cash orders are being taken. This is made necessary by the exigencies of the times. The stock, however, does not seem to be affected in the least under the company's present policy. It is held so largely in small lots by conservative investors that the stringency of the money market has forced very little of it for sale. The officials of the company state that speculative tendencies often noticeable in large corporations of this character are altogether eliminated in the Westinghouse company, and that it is attending strictly to its manufacturing business. They disclaim any intention, past, present or future, to inflate or boom the stock. They say the stock will take care of itself and will be valued by investors by the dividends it pays. The new system of underground street traction announced exclusively in this column last week is to be soon introduced to public notice. It has not yet been sufficiently advertised in news reports to attract the attention that should accrue to such an important step in electrical propulsion, but public trials that are soon to be given to the new system of furnishing power will reveal of what value Mr. Westinghouse's new invention will be. It is bound to be successful, says the inventor. It has qualities that make it far superior both as regards economy and safety to any known system. Naturally, the Westinghouse Electric Company will have the sole right for equipping street car systems with the new invention. This must add materially to the intrinsic value of the stock, as the earning power of the company will be enormously increased by this new achievement.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	25	30
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " " com	15	15	17½
Edison Electric Ill., New York	100	88½	89
" " " lsts	...	98¾	99
Edison Electric Ill., Brooklyn	100	95	100
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	140
Edison Electric Light of Europe	..	2½	5
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	5	6
General Electric Company	100	45⅝	46
" " deb. 5's	..	70	70½
Interior Conduit and Ins. Co	100	30	40
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	16	17
" " pfd	50	37	38

TELEGRAPH AND CABLES.

	Par.	Bid.	Asked.
American District Tel	100	54¾	55
American Tel. & Cable	100	71	73
Central & So. Am. Tel	100	....	111
Commercial Cables	100	137	138
Gold & Stock Tel	100	100	103
Franklin	100	35	40
Mexican Telegraph	...	180	200
Northwestern Telegraph	...	102	104
Pacific and Atlantic	...	50	60
Postal Tel. & Cable	...	....	70
Southern & Atlantic Tel	25	75	82½
Western Union	100	77⅜	77⅞

TELEPHONE STOCKS.

American Bell	...	179½	182
Erie Telephone	.	37	38
New England Telephone	...	48	48
N. Y. & N. J. Telephone	...	90	95
Metropolitan Tel. & Tele Co	...	200	....

AFFAIRS OF THE COMPANIES.

THE NEWPORT (R. I.) ILLUMINATING COMPANY, at its annual meeting, found the treasurer's report to be satisfactory as to the earnings of the corporation. The following directors were elected for the ensuing year: T. A. Havemeyer, F. W. Vanderbilt, H. H. Fay, L. L. Lorillard, Gardner B. Reynolds, A. C. Titus and Henry W. Darling.

THE WILCOX ELECTRIC COMPANY has started in business in Newark, N. J., for the purpose of manufacturing and selling electric railway appliances, building and equipping electric railways, and buying and selling patents. Theo. B. Wilcox, Henry Wilcox, E. R. Dimick and T. P. Huffman, of Newark, and others of New York, are interested. The company starts out with a paid in capital of $150,000.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., recently addressed the following to the New York "Tribune":

"To the Editor.—Sir: We note in your issue of to-day an item to the effect that our company has shut down. It seems to be rather misleading, as one or two of our customers have communicated with us, asking if we have suspended business or merely shut down temporarily. We would consider it a favor if you would insert in your next issue an item to the effect that we have not shut down permanently, but merely closed for two weeks on account of the large stock of goods we have accumulated, and intend resuming operations as usual at the end of that time."

NEW INCORPORATIONS.

COTTAGE GROVE, ORE., has voted bonds in the sum of $5,000, for the purpose of establishing an electric light and water system. Work will be commenced on the plant as soon as the bonds are disposed of.

THE POWELL OIL MILL COMPANY, Bastrop, Tex., capital stock $50,000, has been formed to supply electricity for lighting purposes, etc. The promoters are W. C. Powell, P. O. Elzner and J. L. Wilbarger, all of Bastrop.

THE QUEEN CITY ELECTRIC LIGHT COMPANY, Denver, Colo., capital stock $25,000, has been incorporated to furnish light, heat and power. C. E. Skiles, F. J. Hangs and Wm. Thorn, Denver, Colo., are the incorporators.

THE CENTRAL LIGHT AND POWER COMPANY, Rochester, N. Y., capital stock $25,000, has been incorporated for producing electricity for light, heat and power. J. DeWitt Butts, F. W. Elwood and Geo. Wilson, of Rochester, are the promoters.

THE PORTLAND & HILLSBORO RAILWAY COMPANY, Portland, Ore., capital stock $1,500, has been formed to construct, build and operate electric lighting plants. The interested parties are T. H. Liebe, F. J. A. Mayer and Frank Jobson, Portland, Me.

THE MILLER ELECTRIC COMPANY, 13 Astor Place, New York City, capital stock $5,000, has been formed to manufacture and sell electrical appliances. S. E. Miller, Brooklyn; Sam Shethar, New Castle, and Ed A. Nichols, New York City, are the promoters.

THE SUBURBAN RAILWAY COMPANY OF WEST CHESTER, of Philadelphia, Pa., capital stock $400,000, has been formed to construct and maintain an electric street railway from West Chester, Pa. Wm. Jenks Fell, W. S. Kirk and Mahlon M. Childs are interested.

THE CITIZENS' ELECTRIC LIGHT, HEAT AND POWER Company, of McDonald, Pa., capital stock $12,000, has been formed to supply light, heat and power. The organizers are S. S. Johns, W. A. Jamison, R. M. McCartney and C. R. Buckheit, McDonald, Pa.

THE FRANKLIN AND OIL CITY ELECTRIC STREET RAILWAY COMPANY, Franklin, Pa., capital stock $45,000, has been formed to construct and maintain an electric railway in Franklin, Pa. A. H. McKelvy, J. H. Donly and G. S. Davis, Warren, Pa., are interested.

THE INTERNATIONAL NOVELTY COMPANY, Newark, N. J., capital stock $10,000. has been organized to deal in electric, magnetic and scientific toys, puzzles, etc. W. E. May, Glen Ridge, N. J.; E. Hanley and W. H. Dean, New York City, are the interested parties.

THE WESTERN ELECTRIC HEATING COMPANY, St. Paul, Minn., capital stock $1,000,000, has been formed to manufacture electric heating appliances, articles and apparatus of every description. F. D. Hager, F. P. Luther and C. P. Johnston, all of St. Paul, are the organizers.

THE ECONOMY NOVELTY MANUFACTURING COMPANY, Charleston, W. Va., maximum capital stock, $100,000, has been formed to manufacture and sell electrical supplies, etc. J. Duncan Harrison, E. C. Legg, Baltimore, Md., and J. H. Lee Holcombe, Washington, D. C., are the promoters.

THE NORDLUND ARC LAMP COMPANY, Seattle, Wash., capital stock $15,000, has been formed to manufacture and sell arc lamps and electrical appliances, etc. A. Chilberg, R. J. Wilson, A. Amunds, L. B. N. Nordlund, P. Wickstrom, Chas. A. White and C. M. Nordlund are the promoters.

THE TUCSON WATER, ELECTRIC LIGHT AND POWER COMPANY, Tucson, Ariz., and Atchison, Kan., has been incorporated to supply electric light and power to Tucson. S. Watts, St. Louis, Mo.; H. A. Lawton, Terry Parker, Stanton Park and J. W. Parker, all of Atchison, are the organizers.

THE LONG ISLAND ELECTRIC CONSTRUCTION AND EQUIPMENT COMPANY has recently been organized in Brooklyn, N. Y., for the purpose of doing electrical construction in Brooklyn and on Long Island. The company has opened offices at 153 Broadway, Brooklyn. W. J. Hayden, general manager.

THE SANTA CRUZ ELECTRIC NAVIGATION COMPANY, Santa Cruz, Cal., capital stock $10,000, has been incorporated to own and operate boats, vessels, etc., to be propelled by electricity or otherwise. F. W. Swanton, Jas. McNeil, John Sullivan and F. W. Ely, of Santa Cruz, are the interested parties.

THE NATIONAL STREET RAILWAY CONSTRUCTION COMPANY, New York City, capital stock $5,000, has been formed to manufacture and sell all kinds of electrical and railway supplies. E. S. Perot, Yonkers; C. Gallagher, New York City, N. Y., and Jas. P. McQuaide, Plainfield, N. J., are the incorporators.

THE DUPLEX TROLLEY COMPANY, New York City, capital stock $10,000, has been incorporated to acquire patent rights for appliances for the transmission of electricity. C. E. Chinnock, 157 Sixth avenue; Jos. Bruns, 364 First street.. both of Brooklyn, and D. E. Rose, 286 Elizabeth street, New York City, are interested therein.

THE ATCHISON RAILWAY AND ELECTRIC LIGHT COMPANY, Atchison, Kan., capital stock $250,000, has been formed to build and operate a street railway in that city, and to produce gas and electricity for lighting purposes. E. Morton, New York City; A. J. Harwi, J. C. Fox, B. P. Waggener, D. Kelso, W. P. Waggener and A. W. Simpson, all of Atchison, are the promoters.

THE PORTLAND GENERAL ELECTRIC COMPANY has purchased for $65,000 a site at the corner of Seventh and Alder streets, in Portland, on which it will at once proceed to erect an eight-story office and central station building. The building will be completed the coming winter when the sub-station in the southern part of the town will be done away with, and the reduction of distribution of the high tension currents from Oregon City will be attended to at the sub-station in the new building.

THE EAST SIDE RAILWAY COMPANY, of Portland, Ore., has been granted an extension of time in which to build an electric line on Madison street until July, 1894. A fire occurred recently in the company's power station, on the east side in Portland, but the damage was slight. The company is having two new cars built for its Oregon City line, each 42 feet in length, to carry 52 passengers. A half hourly service has been inaugurated on the line from Oregon City to Gladstone, and thence to the terminus of the Gladstone branch.

THE BIG BONANZA MINING COMPANY, which was recently incorporated in Tacoma, with a capitalization of $10,000,000, is composed in part of the Tacoma and Chicago capitalists who have been making tests in Oregon City for some months past of an electrical reduction process. The company has located claims covering 220 acres of land in eastern Oregon, where there is an immense deposit of low-grade ore. The directors are: Henry Raymond, San Francisco; E. L. Lewis, Chicago; C. B. Askew, California; Stephen Ryder, W. F. Sargent, John W. McKeehan, of Tacoma, and W. C. Bronson and L. E. Rice, of Portland, Ore.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, August 14, 1893.

THE MAYOR has refused to allow any more arc lights for Fifth avenue.

THE BOARD OF ELECTRICAL CONTROL, during July, removed more than 233 miles of wire and 24 poles.

THE GENERAL ELECTRIC Mining and Power Departments will, it is reported, be moved to New York.

THE MATTHEWS & WILLARD MFG. CO., 40 Murray street, New York, manufacturers of artistic bronze and brass lamps and general fixtures, have a display of ornamental goods in this line that are well worth seeing, and especially the line of electric and gas fixtures which this company manufactures.

PITTSBURGH NOTES.

PITTSBURGH, Pa., August 12, 1893.

THE THIRTY-THREE-INCH MILL of the Homestead Steel Works is now operated by electricity. Each roll carriage is equipped with two Westinghouse single-reduction motors, and the operation of the rolls is manipulated from a cab erected above the carriage. A number of other works of the Carnegie interest have been equipped with electrical apparatus recently, and the electric motor is used in many ways.

SHARPSBURG, a little town near here, has hit upon a unique plan of obtaining public improvements. The lighting of the streets has not been satisfactory, in that the borough has been in the habit of shutting off its electric lights on nights when the moon is supposed to shine. The moon, however, did not shine last Monday night, and the electric lights were out. The consequence was a runaway, in which a man was badly bruised and two women were nearly scared to death. There was neither moonlight nor other light, and the man could not see where he was driving, so he dashed into a curbstone and was upset. Fortunately there was no fatality, although there might have been, and the Town Council, which happened to be in session, was so stricken in its conscience, that it passed a resolution, there and then, to keep the electric lights burning every night whether the moon shines or not.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., August 12, 1893.

THE F. E. BELDEN Mica Mining Company, 12 Broad street, Boston, Mass., has declared its regular monthly dividend.

THE CAPITAL STOCK of the Hyer-Sheehan Electric Motor Company, of Stamford, Conn., has been increased from $2,500 to $30,000.

THE WALTHAM ELECTRIC CLOCK COMPANY, Waltham, Mass., which has been temporarily closed, has decided to resume operations.

THE NEW ENGLAND TELEGRAPH AND TELEPHONE COMPANY has declared a dividend of 75 cent. per share, payable Aug. 15, to stockholders of record at the close of business July 31.

THE NORWALK TRAMWAY COMPANY has voted to reduce its capital stock of $250,000 to $100,000. Next spring it contemplates building lines to New Canaan, West Port, Roton Point and Stamford.

THE NATIONAL ELECTRICAL MANUFACTURING COMPANY, Milford, Conn., has installed a large electric plant at its factory for testing purposes and for lighting, having put in two dynamos and the necessary fixtures. The company is very busy on foreign orders and on several very large contracts which are under way.

MR. L. W. BURNHAM, well known in electrical circles as manager of the Electric Gas-Lighting Company, was taken with a stroke of paralysis some two weeks ago; it was expected at first that he would recover, but during the past few days a rapid decline took place, ending in his death, which took place on the morning of Aug. 9. This will be sad news to the late Mr. Burnham's many friends. The funeral services will take place from his late residence, 24 Rill street, Dorchester, Mass. Burial at Palmer, Mass.

CANADIAN NOTES.

OTTAWA, August 12, 1893.

PETERBORO.—The electric street railway was opened for regular traffic on Thursday.

MONTREAL.—A special meeting of the shareholders of the street railway company was held this week for the purpose of authorizing the directors to issue bonds to the extent of $700,000. The necessary authority was given without any opposition and the meeting adjourned.

BRANTFORD, ONT.—Mr. Dwight, of Ontario, was here this week, on behalf of the street railway company, to inquire into the extensions to Cainsville and Echo Place and Terrace Hill. He will submit a report to President Nicholl and the Board at Toronto. There is some talk also, if the line goes to Echo Place, of pushing on to Bow Park.

OTTAWA, ONT.—Notice is given that application will be made to the legislature of Ontario session on behalf of the Ottawa Electric Street Railway Company for an act to amend the charter of the company, so as to enable the company to amalgamate with the Ottawa City Passenger Railway Company.

OTTAWA, ONT.—Notice is given that application will be made to the legislature of Ontario at the next session for an act to ratify and confirm a certain agreement entered into between the Ontario City Passenger Railway Company, the Ottawa Electric Street Railway Company (Limited) and the corporation of the city of Ottawa and to extend the powers of the said corporation so far as may be necessary for that purpose.

MONTREAL.—The total receipts of the Montreal Street Railway Company during the month of July, just expired, were $17,269.39, an increase of $9,000 over the receipts of the same month last year, during which the new regime was inaugurated. The number of miles traveled by the cars during July, 1893, was 282,696, as compared with 93,601 miles during the same month last year. The company has just completed a contract with the Royal electric Light Company for 500 additional horse power.

OTTAWA, ONT.—Notice is given of application to Parliament for an act to incorporate a company to manufacture, produce, supply and dispose of electricity for light, heat, power and other purposes in Canada and to purchase the plant of other companies or to amalgamate with other companies. This application, although made to apply generally to Canada, is supposed to have special reference to the amalgamation of the Ottawa electric light companies which has been talked of for some time past.

ENGLISH NOTES.

(From our Special Correspondent.)

LONDON, August 2, 1893.

ELECTRIC LIGHTING FRANCHISES.—According to the latest returns published by the Board of Trade, 15 electric lighting provisional orders have been granted this year, of which 11 have been granted to local authorities. There are no less than 170 orders in force, of which 66 per cent. belong to local authorities. That the grant of such orders does not always mean business is shown by the fact that of 69 orders granted in 1883 only seven are now in force, all of them belonging to local authorities.

MUNICIPAL ELECTRIC LIGHTING.—The accounts of the Glasgow Municipal Electric Lighting Station for the first 15 months of its existence show a loss of £1,773; as, however, over £2,800 has been set aside for payment of interest on loan and redemption of capital and over £1,300 has been set aside for depreciation, this loss would probably in a limited liability company have been converted into a reasonable profit.——The Municipal Electric Light Station at Manchester came into operation on Monday. This station is run on the five-wire system, and was designed by Dr. John Hopkinson.——On Saturday last the Huddersfield Municipal Electric Lighting Station was opened; this station is on the alternating current transformer sub-station system.

THE CITY & SOUTH LONDON RAILWAY.—For the six months ending June 30 the City & South London Railway, after paying interest on its debentures and preference shares, has managed to scrape together sufficient to pay a dividend of ¾ per cent. upon its ordinary shares. This is not indeed a brilliant performance when looked at merely from the ordinary shareholders' pocket point of view, nevertheless the figures published by this company show that it is continuing to make satisfactory progress. First of all, the total receipts for the first six months of the present year are nearly 8 per cent. more than for the corresponding period of last year, and while the passengers carried show an increase of 12 per cent. and the train mileage an increase of over 15 per cent. upon the figures for the corresponding period the total working expenses are less. "The locomotive and generating" expenses have continued to diminish. When the line came into operation this item was 9d. per train mile; it is now less than 6½d.

News of the Week.

ELECTRIC LIGHT AND POWER.

NUNDA, N. Y., will be furnished with light by the Nunda Casket Company.

MOORESVILLE, IND.—A movement is on foot to erect an electric lighting plant.

GAINESVILLE, TEX.—An electric light plant will probably be built. R. S. Rollins is Mayor.

GETTYSBURG, PA.—The Gettysburg Electric Light and Power Company has been granted a franchise.

INDIANAPOLIS, IND.—The Board of Public Works will increase the number of electric lights from 800 to 1,050.

POTTSVILLE, PA.—The Citizens' Electric Light Company say that they will begin work as soon as granted a charter.

BATAVIA, N. Y.—The opening of bids for the new electric light building has been deferred by the aldermen to Aug. 22.

GALLATIN, MO.—Gallatin is in need of an electric light plant, and there is prospect of one being located there soon.

COLUMBUS, O.—The Columbus Electric Light and Power Company has been granted a valuable city franchise.

COTTAGE GROVE, ORE.—The town voted to issue bonds for an electric light plant. Work will commence as soon as the bonds are sold.

BORDENTOWN, N. J.—John Wiley, of Moorestown, Burlington County, N. J., is asking the privilege of erecting an electric lighting plant in Bordentown.

REEDSBURG, WIS.—A special election will be held to vote on the question of bonding the city for $25,000 to pay for water-works and electric-lighting plant.

BUFFALO, N. Y.—The Buffalo & Niagara Falls Electric Light and Power Company will soon call for bids for the construction of its plant, the main building to be 40 × 80 feet.

LOOMIS, WASH.—Arrangements are being made to build an electric plant to be run by water power and to furnish power for milling, drilling, tramway and lighting purposes.

ROCK FALLS, ILL.—A committee has been appointed consisting of two aldermen and the city attorney to investigate the feasibility of putting in water and electric light plants.

CLEVELAND, O.—A meeting of stockholders of the Cleveland Electric Light Company will be held in August to take action on a proposed issue of $300,000 in bonds for improvements.

OYSTER BAY, L. I., N. Y.—The Oyster Bay Electric Light and Power Company will increase its capital stock by $10,000, and will enlarge its plant with a new dynamo and increased steam power.

HARRIMAN, TENN.—Sealed proposals will be received until Sept. 1 for the construction of an electric light and water-works plant. Specifications to be had from the City Engineer. A. B. Burr, City Treasurer.

FLEMINGTON, N. J.—Messrs. Leiber & Weiler, who have been granted a franchise to construct an electric lighting plant, have made a canvass with such success that they will begin work on their proposed plant as soon as a location can be selected.

JOLIET, ILL.—Unsuccessful bidders for the penitentiary light and power plant threaten legal proceedings, alleging that the contract was not awarded to the lowest bidder, and that the blue prints sent out to bidders by Warden Allen bore the stamp of the General Electric Company and the signature of that concern's engineer. It is charged that the plans and specifications provided for machinery and appliances manufactured only by the General Electric Company and its friends.

THE ELECTRIC RAILWAY.

PIKESVILLE AND EMORY PARK, NEAR BALTIMORE, MD., are to be connected by an electric line.

CANTON, ILL.—A franchise has been granted for a street railway. Col. J. M. Snyder is at the head of the project.

THE BROADWAY (BROOKLYN) RAILROAD COMPANY has been given permission to substitute electricity for horses.

CONYNGHAM AND DRUMS, PA., residents have subscribed $10,000 stock to an electric railway to connect their towns.

THE GETTYSBURG, PA., trolley road has had its franchise over the battlefield confirmed by the State Attorney-General.

THE CONEY ISLAND, FORT HAMILTON & BROOKLYN RAILROAD COMPANY asks for a franchise from Surf avenue to Twenty-third avenue.

SEATTLE, WASH.—A franchise has been granted to Guy C. Phinney for a street railway along and over certain streets and avenues from Yesler avenue and Fourth street to Woodlawn Park.

ST. LOUIS, MO.—Plans for the tracks of the Delmar Avenue & Clayton Electric Railway were submitted to the Board of Public Improvements. This means that the work on the road will commence soon.

WOODSTOCK, N. Y.—Overlook Mountain House, near here, is being improved, and the firm in control, Messrs. A. A. Neal & Co., are forming a syndicate to build an electric road from the base of the mountain.

STILLWATER, MINN.—The Stillwater Electric Railway Company has been in the hands of a receiver for over two years. W. M. Hewitt is receiver, and residents are looking to him to make a move to get capital interested.

PORT VIEW, PA.—The Street Committee of Council has granted right of way through the streets here to the Reynoldton & Port View Traction Company. Work is to begin on the line within 90 days and to be completed in 18 months.

PATERSON, N. J.—Among the directors of the New Jersey Improvement Company, which proposes to build a 40-mile trolley road from here to New Brunswick, are Jacob L. Stadleman, of Bath, Pa., and Chas. E. W. Smith, of Morristown.

FREEPORT, ILL.—The building of the Freeport electric line has been delayed by the state of the money market, but Congressman Haines promises to start Aug. 15, if the franchise is extended, and the City Council has voted to extend it.

SPRINGFIELD, O.—The County Commissioners have granted a franchise to J. N. Neff and his associates for an electric line between Springfield and Xenia. Mr. Neff states that work will be commenced immediately. Bids will be called for ties, etc.

YOUNGSTOWN, O.—Judge Johnson and J. Cal Ewing, of the Youngstown & Canfield R. R., are to meet Pittsburgh capitalists who propose to build an electric line from here to Lanterman's Falls, and they will be asked to combine with the new concern.

NASHUA, N. H.—An electric line is proposed to Haverhill, Mass., with branch lines extending to Manchester, Lowell, Lawrence, Chester and desirable points, also a continuation of the line through Winter street in Haverhill to West Newbury and Newburyport.

GARDNER, MASS.—The Gardner Electric Street Railway Company has been granted a franchise for an electric street railway; the capital stock is $75,000. J. Walter Davis, L. A. Greenwood, J. H. Whiting, G. R. Godfrey and W. Whittemore & Son are interested.

LEGAL NOTES.

LAMP PATENT SUIT.—The Edison Electric Light Company, of New York, and the Edison Illuminating Company, of Detroit, have begun suits in the United States Circuit Court in Detroit against the Huyett & Smith Manufacturing Company and the Detroit Confectionery and Fruit Tablet Company to restrain further infringement of the Edison patent for incandescent lamps and to collect damages for past infringements.

LIABILITY OF TELEPHONE COMPANY FOR INJURIES FROM CHARGED WIRE.—Where a telephone company has permission from an electric light company to string its wires along the latter's poles where the telephone company wishes to connect a residence where it has no poles, and the telephone company disconnects a residence, and, instead of removing the wire, coils it up and hangs it on an electric light pole, the telephone company is bound to look after the wire; and if it fails to do so, and the electric light company remove the pole and hang the wire on a telephone pole, whereby it becomes charged with electricity from an electric light wire, and injures a pedestrian on the sidewalk, the negligence of the telephone company is the proximate cause of the injury. (Ahern v. Oregon Telephone and Telegraph Company, Supreme Court of Oregon, 33 Pac. Rep., 403.)

USE OF POLES BY ELECTRIC LIGHT COMPANIES.—Where a statute provides that companies incorporated to furnish electricity and electric lights may lay, construct and maintain conductors for conducting electricity through the streets with the consent of the municipal authorities thereof, under such reasonable regulations as they may prescribe, a Manistee city ordinance provides that all poles erected in such city for electric lighting, on payment of a reasonable portion of their cost, shall be under control of the Council, so far as to permit their use by other persons for electric lighting. A resolution passed by the Council of such city, empowering an electric light company to use the poles of another company without fixing the limits of such use, or regulating the manner in which each is to start its wires, is unreasonable and void. Under the statute as above set forth, the Manistee city charter, giving the Council authority to light the public grounds within the city, and giving the Council control over placing of poles in or over the streets, such city may make contracts for electric lighting with individuals as well as with corporations organized for such purposes. (Citizens Electric Light and Power Company v. Sands, Supreme Court of Michigan, 55 N. W. Rep., 452.)

LIABILITY OF MUNICIPAL CORPORATIONS FOR DEFECTIVE STREETS.—In an action against the city for personal injuries caused by a defect in a street there was evidence that one was hurt by a discharge of electricity from a loose wire which he took hold of to remove from the street; that the wire was an acoustic one, and was used without electricity, but that it touched an electric wire which had lost its insulation at the point of contact; that the acoustic wire had been hanging loose for three weeks in such a position that the wind might bring it against the electric wire, and that the want of insulation could be seen from the street. There was evidence from which the jury could find that the likelihood of the defect coming into existence should have been obvious to the city's inspectors of wire during the three weeks, and therefore the city ought to have known of the defect within a time after it came into existence so short that it might fairly be presumed to have elapsed when the accident happened. A request to charge that if the negligence of the respective owners of the electric and acoustic wires contributed to the accident without which there would have been no injury, he could not recover, was properly refused since the only way in which the owners could have contributed to the accident was by helping to create the defect, and the liability of the city was for not abating it. (Bourget v. City of Cambridge, Supreme Court of Massachusetts, 34 N. W. Rep., 455.)

PERSONAL NOTES.

MR. CAMILLO OLIVETTI, of Milan, Italy, an Italian electrical engineer of note, accompanies Prof. Ferraris on his visit to America.

MR. TITO BARRETO GALVAO, of Rio de Janeiro, one of the Brazilian World's Fair Commissioners, was in New York last week where he made a number of visits of inspection to central stations and other places of electrical interest.

PROF. GALILEO FERRARIS, of Turin, Italy, arrived in New York Sunday, Aug. 7, and will be the only representative of the Italian government at the World's Fair. Professor Ferraris is delighted at the recovery of his rotary magnetic field models, which were on a ship that sank in the harbor of Genoa. They are now on exhibition in the rooms of the American Institute of Electrical Engineers, Electricity Building, World's Fair Grounds.

MISCELLANEOUS NOTES.

THE CANADIAN ELECTRICAL ASSOCIATION will hold its convention in Toronto on Sept. 12, 13 and 14 in the Industrial Exhibition Building. A feature will be a grand electric display by electrical exhibitors and experiments on currents of high frequency and tension.

THE GRAND OPERA HOUSE will now have electric lights. The late Jay Gould persistently refused to allow the use of electric lights in the Grand Opera House, and this was one of the reasons that decided T. Henry French to relinquish the lease of the house. George Gould does not share his father's prejudices, and an electric plant is now being established in the opera house, which will add greatly to the effectiveness of stage pictures.

A CONGRESS OF INVENTORS.—A congress of inventors and friends of patents and trade-marks will be held in Chicago, for one week, commencing Monday, Oct. 2, under the direction of the American Association of Inventors and Manufacturers in connection with a committee of the World's Congress Auxiliary of the Columbian Exposition. Hon. Ephraim Banning, of Chicago, has been appointed chairman of this congress. A large number of gentlemen, eminent in their respective departments in this and foreign countries, have promised either to attend and read papers or to prepare papers on different subjects relating to inventions and patents. Among these papers will be one by Dr. R. J. Gatling, president of this association.

AN ADVERTISEMENT in a Cleveland (Ohio) paper furnishes the following information that may possibly be news to readers of The Electrical World: "On Sunday, Aug. 13, Mr. J. E. De Leon, the young electrician of Buffalo, and possible rival of Edison, will give a notable exhibition at Forest City Park. He handles the current with perfect ease and safety, walking on a bare wire charged from the arc lighting circuit, which is powerful enough to kill an ordinary man, his body meanwhile brilliantly illuminated by the current which is conducted through it. The entire apparatus is of his own invention and construction and exhibits inventive genius of a high order."

Trade and Industrial Notes.

THE TICE-LINTNER ELECTRIC COMPANY, Edison Building, Minneapolis, Minn., sends us a pamphlet descriptive of its well known potential indicator. Those connected with lighting and electric railway plants will find this of interest.

THE ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT, of Berlin, Germany, has issued a handsome 32-page brochure giving an illustrated account of its exhibit at the World's Fair. The descriptions are well written and sufficiently technical to have a professional value.

THE FORD-WASHBURN STORE ELECTRO COMPANY, of Cleveland, is at work on an electric car equipped with 180 cells of its storage battery, to be used on the new electric road between Cleveland and Berea, eight miles. It is expected that the first car will be ready about Sept. 1 and will be followed by others.

THE CENTRAL ELECTRIC HEATING COMPANY, 26 Cortlandt street, New York, has issued a well gotten up 40-page catalogue of the numerous electric heating apparatus which it has recently placed on the market. To those who do not know

what advances in this line have been recently made, this well illustrated book will be a revelation.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburgh, Pa., has issued another of the superb catalogues for which it is noted, the present one containing illustrations alone of their standard apparatus. Those who get out catalogues would do well to study the Westinghouse productions in this line for pointers.

THE ABENDROTH & ROOT MFG. CO., 28 Cliff street, New York, has issued a folder giving in very concise terms a resume of the many advantages of their well known Root improved water tube boiler and also a clear description of the boiler itself. The five large illustrations give an excellent idea of the boiler and enable the description to be easily followed.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received the contract for the new power station for the Atlantic Improvement Company, Astoria, L. I. There will be two buildings, a boiler house 62 feet wide and 85 feet long, with a dynamo room 70 feet wide and 130 feet long. The dynamo room is controlled by a traveling crane, to be furnished by the same parties.

H. LAMARCHE'S SONS, 83 John street, New York, send us two handsome books issued by the Vielle Zinc Company, of Chenee, Belgium. One is bound in cloth, and devoted to zinc as a roofing material, and a number of views in colors show different systems of roofing with zinc. The other was issued for the World's Fair, and contains a history of the Belgian company, with a long list of different uses to which their manufactures are applied.

THE ANSONIA ELECTRIC COMPANY, Chicago, has placed some very large contracts for railway material within the last few weeks. Its new adjustable pipe bracket, as well as the new insulators, is meeting with great success, and is being rapidly adopted as standard material by a large majority of electric roads. The Ansonia company guarantees these fixtures for strength and insulation, and agrees to replace any material which on account of defect does not prove satisfactory.

THE WILMOT & HOBBS MANUFACTURING COMPANY, Bridgeport, Conn., has secured another large contract from the U. S. Government for its cold rolled "Swedoh" steel, which is being used for some very severe stamped and drawn work that the government has been making for some time. This steel, after being submitted to some very severe competitive tests, has been demonstrated to b very superior to anything heretofore used for this work. We understand this company is making quite a specialty of it.

THE PENINSULAR ELECTRIC AND ENGINEERING COMPANY, of Grand Rapids, Mich., has recently started in business for the purpose of doing general electrical contracting and dealing in electrical apparatus and supplies. The company is composed of W. S. Sherman and S. D. Kopf, who until recently were with the Peninsular General Electric Company and Peninsular Electric Company. Both gentlemen have had a large amount of experience, and engage in business for themselves with the intention of giving every attention to detail, handling only the most improved apparatus, and installing only first-class work.

THE RELIANCE GAUGE COMPANY, OF CLEVELAND, O.—Our readers, in viewing the various illustrations of the World's Fair power plant, have probably noticed that the boilers are nearly all equipped with Reliance safety water columns, there being eight on the Heine, nine on the Campbell & Zell, four on the Stirling and three on the Climax boilers. The distance between the high and low water alarm lines on the different columns varies from eight inches to 24 inches, the latter being on the largest Climax vertical boilers. The columns are made by the Reliance Gauge Company, Cleveland, O., who will furnish any desired information.

BRYAN, MARSH & CO., of 136 Liberty street, New York, state that many exporters and shippers are learning the value of chromite, the new dry compound, and are shipping it in place of battery acids and electropoion. A large saving in freights is effected, as 25 to 27 pounds of chromite equals a carboy of electropoion; all carriers, moreover, accept chromite, which is not the case with liquid acids. By reason of the exact proportions of chromic and sulphuric acids that enter into its composition, a higher E. M. F. is assured in all battery work by its employment than by acid solutions generally used; 2.15 volts are obtained on open circuit from zinc carbon batteries.

THE CUMMINGS & ENGLEMAN CONDUIT COMPANY, of Detroit, Mich., who are manufacturers of the Cummings Underground Trolley Railway System and Underground Conduits, and who have recently established a large factory on Congress street, between Third and Fourth streets, with an office in the new Telephone Building, are receiving liberal orders for their underground conduit system, which are keeping them at present very busy. They are now putting down in Chicago for the Co-operative Electric Light Company (Siemens & Halske system), who have a franchise for 20 miles, 13 miles of this conduit for bare copper wire conductors for 2,000 volts alternating. The Detroit Electric Light and Power Company are using this same system, as well as the St. Paul Edison Company. They have recently taken a contract from the Chicago Street Railway Company for their feeders, and are now contracting with parties at San Francisco, Cal., for their underground trolley railway system. They guarantee their low-tension conduit to take care of as high as 5,000 volts and the high tension 10,000 volts, with bare copper conductors. They claim there is no other conduit system similar in the market that can handle bare copper conductors yet introduced. A visit and inspection of their system now in operation will find it remarkable for its efficiency and simplicity.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse N. Y.

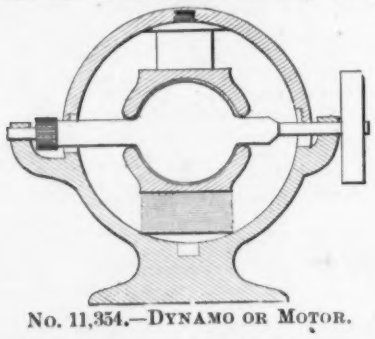
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED JULY 25, 1893.

[IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.]

11,354 (reissued). DYNAMO OR MOTOR; Ralston C. Kintzing, New York. Application filed March 1, 1893. A dynamo or motor having its pole pieces and armature inclosed in a two-part magnetic sphere. (See illustration.)

501,911. CARBON HOLDER FOR ELECTRIC ARC LAMPS; Sigmund Bergmann, New York. Application filed Oct. 22, 1892. A rack bar of an electric arc lamp provided with a



No. 11,354.—Dynamo or Motor.

concave end in combination with a convex-headed carbon holder, a spring and a screw for securing the parts together.

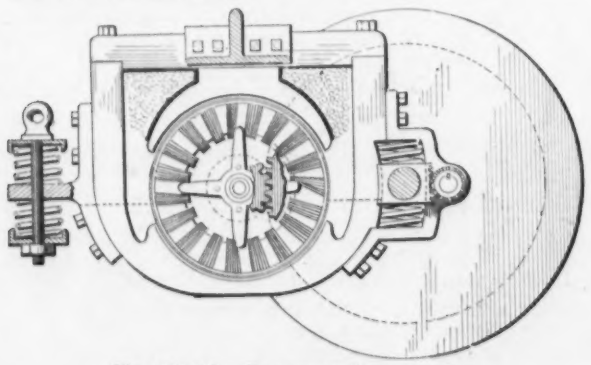
501,938. CARBON HOLDER FOR ELECTRIC ARC LAMPS; F. D. Hazleton, New York. Application filed Jan. 10, 1893. In combination with the rack a bar, a U-shaped crosswise adjuster frictionally secured thereto, a lateral adjuster frictionally secured to the crosswise adjuster, a clamping bar, springs and screws for holding the carbon firmly in place.

501,960. COMMUTATOR BRUSH; H. G. Reist, Lynn, Mass. Application filed March 15, 1893. A commutator brush composed of laminae connected together at their rear ends and inclosed between backing plates, the laminae having transverse slits whereby the specific resistance of the brush is increased.

501,961. MEANS FOR REGULATING ELECTRIC MOTORS; C. H. Richardson, Philadelphia, Pa. Application filed Jan. 16, 1893. The combination of an electric motor for doing external mechanical work, generating coils electrically separate from the motor armature and mechanically connected with and driven by the motor shaft, and a variable resistance in circuit with the generating coils, whereby provision is made for controlling the speed of the motor armature shaft while maintaining nearly constant the torque or pull thereon at any given speed determined by the adjustment of the resistance.

501,968. ELECTRIC RAILWAY TROLLEY; E. A. Sperry, Chicago, Ill. Application filed April 1, 1892. The combination of a mining motor car with a trolley pole socket secured to its side, and a trolley pole swiveled in this socket and pivoted so as to move in a vertical plane, this trolley pole being of a length less than the width of the car.

502,007. ILLUMINATED SIGN; A. L. McCormick, Port Huron, Mich. Application filed Feb. 17, 1893. The combination of a sign or design having transparent letters or parts on an opaque field, in front of a series of cells separated by walls and containing each a number of lamps of different colors, with a commutator arranged to change the current from lamp to lamp in each cell while supplying a current to several cells simultaneously.



No. 502,020.—Electric Locomotive.

502,020. ELECTRIC LOCOMOTIVE; E. A. Sperry, Chicago, Ill. Application filed Oct. 23, 1891. In an electric machine, the stationary axle, a rotating hollow armature shaft combined with a non-metallic sleeve mounted within and rotating with the armature shaft forming a bearing therefor. (See illustration.)

502,022. ELECTRIC MEASURING INSTRUMENT; Elihu Thomson, Swampscott, Mass. Application filed Feb. 17, 1893. An electric measuring instrument composed of a vertically suspended horseshoe magnet with its poles closely approximated and a plate interposed between them, the plate conducting the current to be measured through the field of the magnet.

502,038. PIPE COUPLING; Reinhold Herman, Crafton, Pa. Application filed May 2, 1893. In a pipe coupling, the combination of two internally threaded sockets, one of the sockets being provided with an externally threaded head or enlargement, and the other with a concavo-convex bowl, a bearing block formed of insulating material attached to one of the sockets and provided with a packing ring, an annular disc formed of insulating material and fitting over the bowl of the other socket, and an internally threaded sleeve provided with a flange for engagement with the annular disc and adapted to screw on to the externally threaded socket.

502,040. RHEOSTAT; C. A. Hussey, New York. Application filed May 23, 1892. The combination of an electric lamp socket or holder with a block of insulating material provided with cavities containing conducting material mixed with powdered peroxide of manganese, and so arranged that more or less of the material may be thrown into or out of the circuit to vary or extinguish the light.

502,077. ELECTRICAL MEASURING INSTRUMENT; R. M. Hunter, Philadelphia, Pa. Application filed March 28, 1893. The combination of a movable pointer, an expansion wire over which the electric current to be measured passes, a spring to keep the expansible body under tension, a movable pointer and a compensating mechanical connection over which no current passes between the pointer and expansible body, whereby the pointer will not move for variations in temperature of the surrounding atmosphere.

502,083. JUNCTION BOX; E. J. McEvoy, New York. Application filed Jan. 3, 1893. In a system of electric wiring, comprising wire-containing moldings and a junction box, a joint between the junction box and a molding.

502,088. TROLLEY WIRE AND HANGER; E. P. Wetmore, Helena, Mont. Application filed Dec. 23, 1892. The combination of a trolley wire provided at intervals with undercut grooves or depressions, and a pair of clamping jaws fitted into the grooves or depressions. (See illustration.)

502,091. SYSTEM OF TELEPHONIC INTERCOMMUNICATION; F. R. Colvin, New York. Application filed Oct. 15, 1892. The combination of an electromagnet, a visual signal which is released from its concealed position by the attraction of this magnet, a circuit closer which is actuated by the signal when in its displayed position, and a shunt circuit which, when closed by the action of the circuit closer, bridges or short circuits the electromagnet.

502,098. ELECTRIC MOTOR FOR ROTARY DRILLING MACHINES; R. M. Jones, Salt Lake City, Utah. Application filed Dec. 22, 1892. The combination with an inclosing cylindrical casing for an electric motor, having packed bearings in its ends for the tubular armature shaft and made of non-magnetic metal, of a motor mounted in the casing and fixed in place by having its field magnets secured to circular keepers which form part of the inclosure.

502,103. MUSICAL INSTRUMENT; Konstantin Polenoff, Nishue Tagulsk, Russia. Application filed Sept. 7, 1891. In mechanism for acting on keyboard musical instruments, the combination of an electromagnet and an armature therefor, with a key to which the armature is secured, a washer secured to the under side of the armature and adapted to enter one of the tubes of the electromagnet.

502,104. ELECTRIC SWITCHING APPARATUS; A. R. Roe, Duluth, Minn. Application filed Sept. 24, 1892. The combination with a plurality of electric switches, two reciprocating rods operating each, a plate or frame provided with openings and having two movements, one to determine how its openings shall be placed with respect to the rods, and the other toward or against the rods.

502,105. ELECTRIC SWITCHING APPARATUS; A. R. Roe, Duluth, Minn. Application filed Oct. 28, 1892. The combination with a plurality of electric switches, movable rods or levers controlling the respective switches, a plate or frame adapted to move against the rods or levers to operate switches and selecting devices carried by the plate or frame, determining how many and which of the switches shall be operated. (See illustration.)

502,156. SELF-WINDING AND SYNCHRONIZING CLOCK; A. G. Wiseman, St. Louis, Mo. Application filed Oct. 28, 1892. In a clock the combination of a single magnet, an armature lever, mechanism operated by this magnet and lever to wind the clock, and mechanism operated by the same means to synchronize the clock, whereby but one magnet and armature is required to both wind and synchronize.

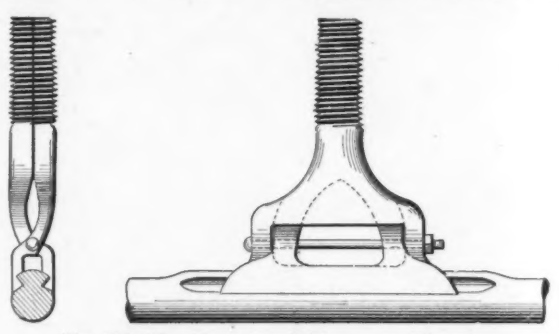
502,157. ELECTRIC CLOCK SYNCHRONIZER; A. G. Wiseman, Webster Groves, Mo. Application filed April 29, 1892. In this mechanism there is an armature, armature lever, seconds hand, a shaft giving motion to the seconds hand and a wheel having frictional connection with the shaft and mechanism between the armature lever and the wheel adapted to rotate the wheel by the simple movement of the armature lever.

502,166. ELECTRIC ARC LAMP; P. J. Barrett, Boston, Mass. Application filed April 5, 1893. This comprises converging carbon holding tubes, a support for them, carbons arranged to move downward through the tubes, a brake mechanism to control the movement of the carbons, ball followers arranged in the tubes above the carbons, and electrical connections for the carbons.

502,207. ELECTRIC SIGNAL FOR FIRE-ALARM SYSTEMS; Joseph Sachs, New York. Application filed April 10, 1893. The combination with a device for actuating a signal sending box so as to send its signal, of a differential magnet, having one of its coils in the circuit containing the actuating device and a battery and the other coils in a circuit containing a battery and auxiliary signal boxes, and means for sending a return signal from the actuating device to the first circuit and then to actuate the return call in the auxiliary boxes.

502,215. ELECTRIC WINDING ATTACHMENT FOR CLOCKS; A. G. Wiseman, St. Louis, Mo. Application filed July 30, 1892. This consists of an electric clock winder, having an armature carrying a pawl, a ratchet wheel actuated by this pawl, an insulated spring on the armature connected with the magnet and receiving the contact of the spring in one position of the armature.

502,216. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; Frank Wynne, London, England. Application filed April 3, 1891. The combination of an insulated main conductor, a series of insulated road contacts normally disconnected from the main conductor, arranged in advance of the other with spaces between them in the longitudinal direction of the

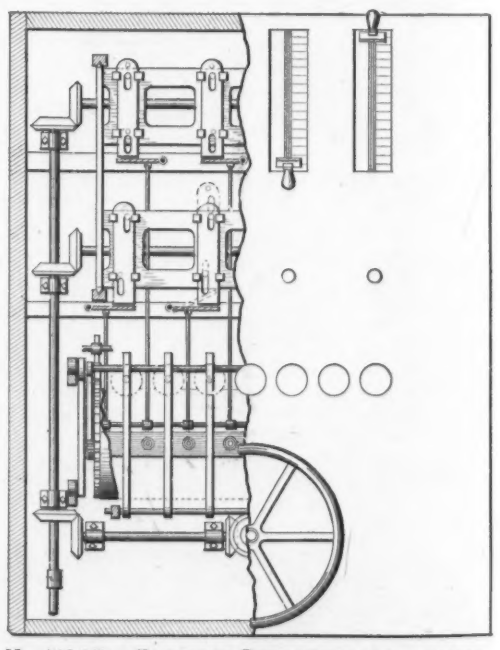


No. 502,088.—Trolley Wire and Hanger.

road and connected across each alternate space by conductors to form independent pairs of road contacts and a series of contact-making devices each in circuit with one of the conductors.

502,229. CONNECTOR FOR TRACK CIRCUITS; E. H. Goodman, Pittsburgh, Pa. Application filed Nov. 1, 1892. An electrical rail connector having pins and a body portion formed integral with each other, the heads consisting of two parts of wire parallel or approximately parallel with each other and formed by folding the wire upon itself.

502,243. ELECTRIC RAILWAY TROLLEY; C. J. Van Depoele, Lynn, Mass. Application filed Aug. 9, 1888. A car provided with a contact-carrying arm having a contact device at its free extremity and mounted at its lower end on a transverse axis carried by a support located on the top of the car.



No. 502,105.—Electric Switching Apparatus.

502,262. TELEPHONE CABLE; Wm. R. Patterson, Chicago, Ill. Application filed July 30, 1892. The combination of two or more pairs of wires, the wires constituting the different pairs being twisted together with an undulating or varying degree of twisting, the strands being laid in the same cable to break joints with respect to the different undulations of twisting, whereby cross talk is prevented.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.